Section 2.306 Site Specific Water Quality Study for Chloride, Sulfate, and TDS

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1.0 INTRODUCTION

1.1 Background

This report presents the documentation developed in support of a proposed third-party rule making to address the existing final permit limits for dissolved minerals in the El Dorado Chemical Company's (EDCC) NPDES permit (AR0000752). The documentation was developed in accordance with the project study plan developed for the aquatic life field study and as submitted to ADEQ for their review and comment (Appendix A). This documentation is required by Section 2.306 of the Arkansas Water Quality Standards (WQS) in support of the proposed modifications of designated but non-existing and unattainable uses and associated water quality criteria for dissolved minerals (sulfates, SO_4; chlorides, Cl^- and total dissolved solids, TDS) as summarized in Section 2. This report also addresses the requirements of the 1994 Administrative Guidance Document of the ADEQ, which clarifies the Section 2.306 documentation process.

In addition, this report provides documentation regarding the attainability of the domestic water supply use from the perspective of the 40 CFR 131.10(g) rationale for use removal. The requirement for providing 40 CFR 131.10(g) documentation is to fulfill USEPA Region 6 requests for inclusion of use attainability information in the third party rule making process.

EDCC has operated a fertilizer and acid manufacturing, storage, and distribution center in, El Dorado, Arkansas, Union County since 1983 (Figure 1.1). Current production capacity is approximately 4,000 tons per day (tpd). Recent decreases in waste water effluent dissolved solids (especially SO_4 and TDS) have resulted from environmental improvements directed at process controls, waste prevention and recycle programs which were implemented by EDCC within the last three years. In addition, EDCC's ground water conservation initiative has resulted in further reductions in the Outfall 001 mineral concentrations. This conservation effort includes the use of river water rather than well water from the Sparta aquifer as the source for makeup to the process water supply. This conservation effort further decreases the TDS and Cl loading to the wastewater treatment system.

EDCC has invested over $2,000,000 in improvements and pollution prevention activities during the last fiscal year alone. In addition to reductions in the mineral constituents, reductions in other constituents (e.g. ammonia) have been recognized as a result of facility upgrades and improvements. These reductions are demonstrated in both the effluent concentrations and the routine whole effluent toxicity testing completed routinely on Outfall 001 effluent. (See Section 3). Within the last year, there has been no effluent lethality demonstrated for either two species tested at a critical dilution of 100% effluent.

However, since the wastewater treatment is not designed to remove dissolved minerals (and since there is no economical treatment technology available for the removal of dissolved minerals), the dissolved mineral concentration of the discharge from Outfall 001 will not meet the existing ecoregion criteria.

Despite the reductions realized through the implementation of site BMP and waste water treatment improvements (which are described in detail in Section 3.3.4), the existing NPDES final limitations for SO_4, Cl and TDS will not likely be attained through facility upgrades and improvements. Since the discharge from Outfall 001 is into an unnamed tributary in the Gulf Coastal Ecoregion, the final permit limitations are based on the ecoregion criteria and reflect the least disturbed gulf coastal ecosystem default values.

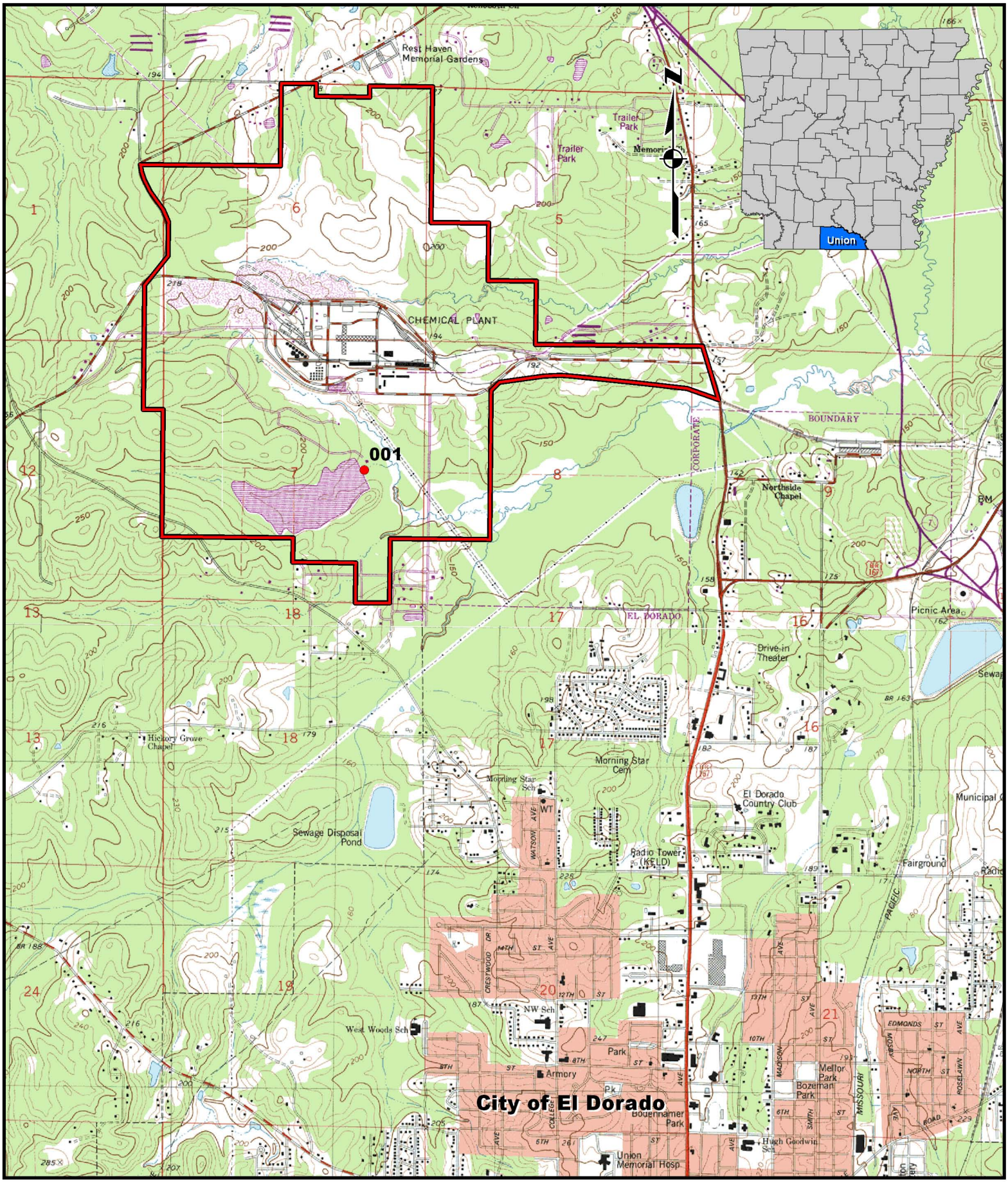

Figure 1.1. El Dorado Chemical Company property boundary, Outfall 001 and surrounding areas.

1.2 Report Focus and Objective

The focus of this report is the discharge from the treated process wastewater outfall (Outfall 001) covered under EDCC's current NPDES permit. The primary discharge (Outfall 001) is into an unnamed tributary (UTB) to Flat Creek. Outfall 001 contains or potentially contains concentrations of Cl, SO_4, and TDS that are in excess of the existing ecoregion specific water quality criteria.

The primary report objectives are to:

- provide the required documentation to support a third-party rulemaking in accordance with Section 2.306 to remove the designated and unattainable domestic water supply use from the sections of unnamed tributary to Flat Creek, sections of Flat Creek, and Haynes Creek to the confluence with Smackover Creek and

- propose site-specific water quality criteria for dissolved minerals (Cl, SO_4, and TDS) that:

  - reflect the current discharge concentrations, (which have been reduced substantially from historical concentrations through extensive facility upgrades to BMP's and spill control and containment),

  - account for recent reductions in mineral concentrations related to site improvements, and

  - are shown to support the designated seasonal fishery use and the supporting biotic communities to maintain that use.

This documentation summarizes significant findings and provides recommendations (Section 2.0), provides a summary of the site's background information (Section 3.0), documents the physical, chemical, and biological characteristics of tributaries that receive the permitted discharges from the targeted outfalls (Section 4.0), and presents the mass balance modeling results (Section 5.0). Section 6.0 provides a review of alternatives to meet the existing ecoregion criteria or stream criteria for dissolved minerals as well as the attainability of the domestic water supply use of the unnamed tributary to Flat Creek, Flat Creek, and Haynes Creek, respectively. Section 7.0 provides the citation for documents referenced in this report.

2.0 SIGNIFICANT FINDINGS AND RECOMMENDATIONS

2.1 Significant Findings

The following findings are based on the information developed as part of the documentation in support of the proposed rule making and as directed by the aquatic life field survey (Appendix A).

1. Recent process improvements, emissions control equipment, improvements to site BMPs and spill prevention, facility containment improvements, recycle of internal process waters, and the ground water conservation activities (moving from Sparta aquifer ground water to river water as a source water), have been responsible for the recent decreases in sulfates, Cl and TDS in the treated effluent discharged through Outfall 001.
2. The facility manages water discharges under the NPDES permit AR0000752.
3. The historical and existing discharges have, on occasion, exceeded the water quality based ecoregion mineral criterion.
4. The facility certifies that it maintains a Storm Water Pollution Prevention Plan and a Spill Prevention Control and Countermeasure Plan and is updated on a routine basis.
5. The SWPPP and the SPCC plans are in the process of revision and updates will be implemented in the fall of 2006.
6. Despite the recent reductions realized by process and facility modifications, the final permit imitations for SO_4, Cl and TDS will likely not be attained as a result of continued site improvements.
7. The final permit limitations for SO_4, Cl and TDS are based on least disturbed ecoregion reference water quality criteria which do not reflect the receiving stream (Flat Creek) condition and the historical dissolved mineral residuals resulting from the oil and brine industry within the watershed.
8. As a result of the historical watershed activities, the ecoregion criteria for the Gulf Coastal ecoregion are exceeded by the “upstream” waters prior to the discharge from Outfall 001, as well as in Flat Creek above the mouth of the receiving stream into which the Outfall 001 occurs.
9. Historical exposures and existing land use within the Flat Creek watershed result in continuing dissolved mineral concentrations that are approximately 3 times that of the unnamed tributary, including the contribution for Outfall 001.
10. Outfall 001 discharges to an unnamed tributary to Flat Creek.
11. The water quality of the discharge from EDCC improves the water quality of the unnamed tributary and thus that of Flat Creek.
12. The watershed into which Outfall 001 discharges is approximately 2.5 square miles at the confluence with the unnamed tributary to Flat Creek. The watershed of the unnamed tributary at the mouth of Flat Creek is approximately 16 square miles (Figure 2.1).
13. During the aquatic life field survey, the unnamed tributary into which EDCC discharges maintains a seasonal fishery to the degree supported by the existing habitat and maintains an aquatic life use in downstream segments.
14. It is anticipated that the state resource agencies will confirm that the domestic water supply use is not an existing use, nor is it an attainable use on Flat Creek.
15. Proposed modifications to the mineral criteria will not preclude the attainment of the other designated and attainable uses.

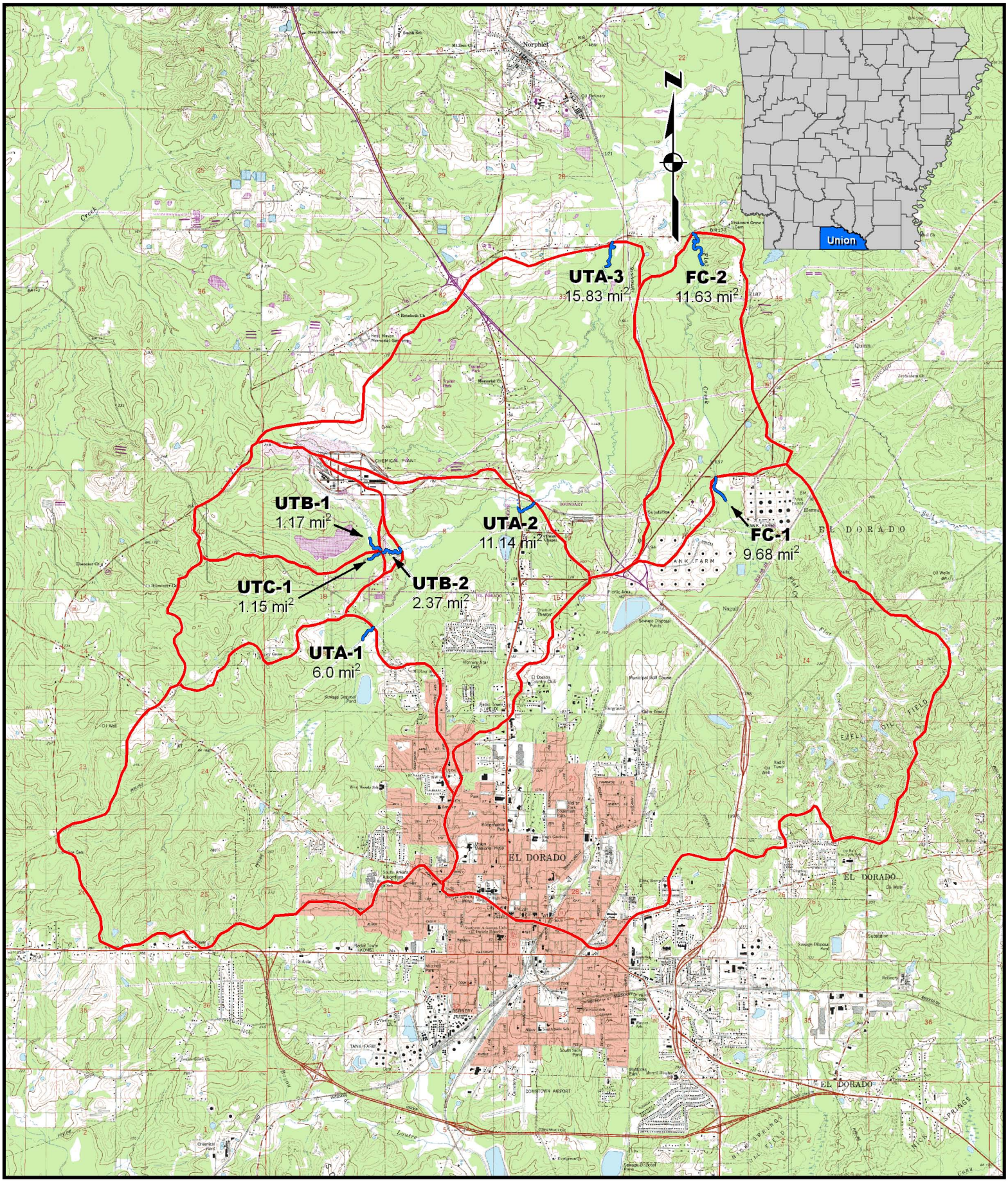

Figure 2.1. Study reaches, watershed boundaries and watershed sizes for stream segments evaluated in association with the EDCC 3rd party rulemaking. April 2006.

2.2 Recommendations

Based on the documentation presented herein, it is recommended that the designated domestic water supply use be removed from the following locations:

- Unnamed tributary to Flat Creek from the discharge from Outfall 001 downstream to its confluence with Flat Creek,
- Flat Creek to the mouth of Salt Creek, and
- Haynes Creek to its confluence with Smackover Creek.

Table 2.1 summarizes the recommended changes to designated uses and the water quality criteria for Cl, SO_4 and TDS of individual streams segments evaluated.

Table 2.1. Summary of Proposed WQS Modifications.

Unnamed tributary to unnamed tributary to Flat Creek (UTB) – from EDCC 001 Discharge to the confluence with Unnamed tributary of Flat Creek (UTA)	**Unnamed tributary to Flat Creek (UTA)– from confluence of UTB to the confluence with Flat Creek**
Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use
Instream Criteria	**Instream Criteria**
Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 23 mg/L; Sulfate from 31 mg/L to 125 mg/L, and TDS from 123 mg/L to 475 mg/L	Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 16 mg/L; Sulfate from 31 mg/L to 80 mg/L, and TDS from 123 mg/L to 315 mg/L

Table 2.1 (cont). Summary of Proposed WQS Modifications

Flat Creek – from mouth of UTA tributary to the mouth of Haynes Creek	**Haynes Creek from confluence of Flat and Salt Creeks, downstream to confluence with Smackover Creek**
Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use
Instream Criteria	**Instream Criteria**
Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 165 mg/L; Sulfate from 31 mg/L to 67 mg/L, and TDS from 123 mg/L to 560 mg/L	Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 360 mg/L; Sulfate from 31 mg/L to 55 mg/L, and TDS from 123 mg/L to 855 mg/L

3.0 BACKGROUND

3.1 Introduction

EDCC operates a chemical and fertilizer manufacturing and distribution facility in Union County on the north side of El Dorado, Arkansas. The facility's single treated process wastewater outfall (Outfall 001) discharges to an ephemeral unnamed tributary (UTB) to Flat Creek (Figure 2.1). A detailed description of Outfall 001 and its' individual discharge characteristics are provided in Section 3.2. For the purpose of this report, only EDCC's Outfall 001 will be addressed. EDCC currently has additional NPDES permitted outfalls that are not considered as significant sources of minerals to the receiving streams due to their discharge locations, small/limited flows, or chemical characteristics. Current plans for continued facility upgrades and improvements include routing of all site storm water into catchment basins and ultimately routed through the primary Outfall 001 discharge. It is anticipated that all flows from the facility will ultimately be routed and discharged through Outfall 001.

The Arkansas Water Quality Standards - Regulation No. 2 (WQS) (ADEQ, 2004) allows modification of water quality standards under various conditions. Specifically, Section 2.306 of the WQS allows the removal of a designated use other than a fishable or swimmable use, and for establishment of less stringent water quality criteria without affecting fishable or swimmable uses. This project report documents the information required to amend Reg. 2 through third party rulemaking. The study areas are shown in Figure 3.1.

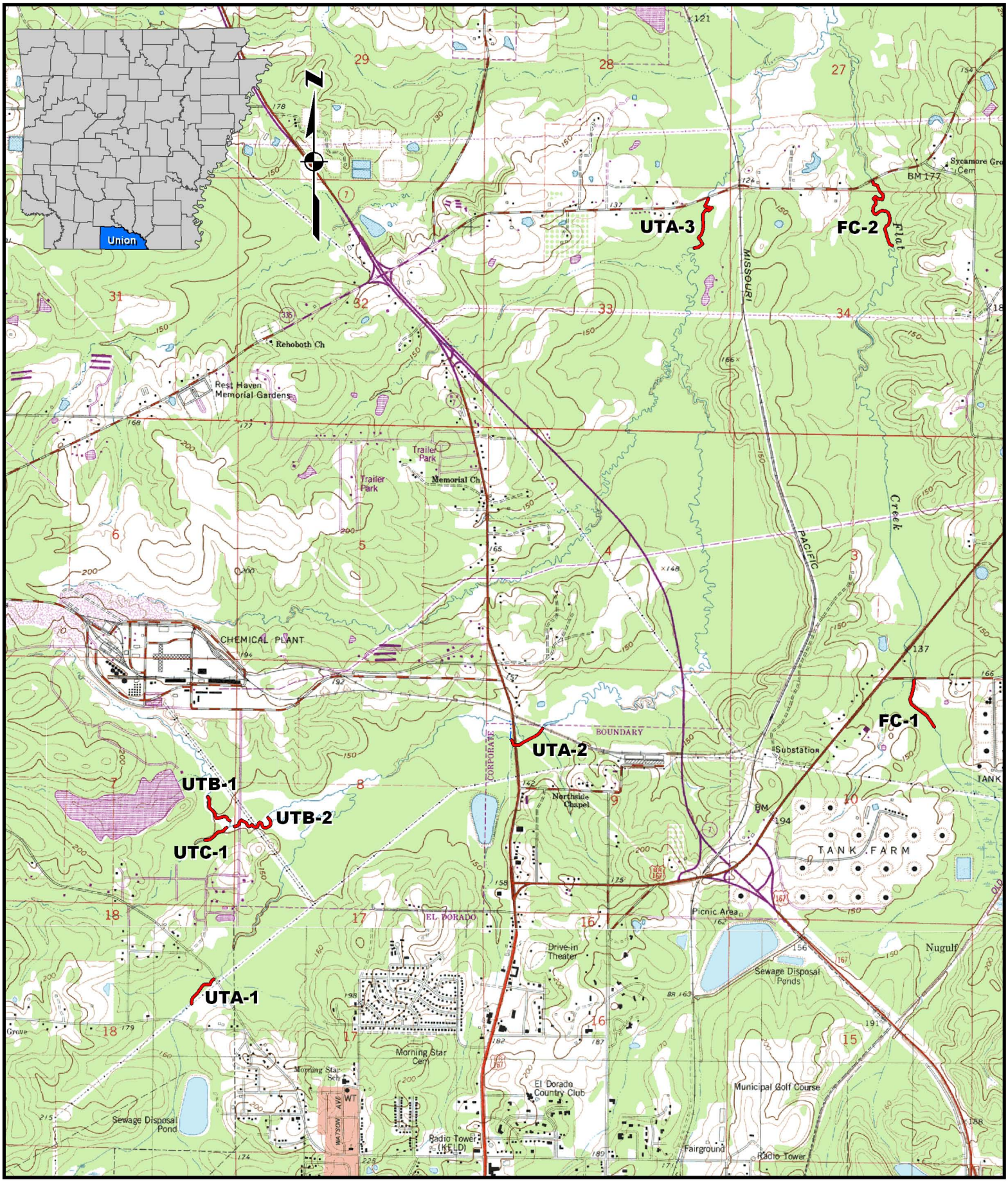

Figure 3.1. Study reaches for EDCC section 2.306 aquatic life field survey. Union County, AR. April 2006

3.2 Designated Uses

The designated uses for Unnamed tributary to unnamed tributary to Flat Creek (UTB), Unnamed tributary to Flat Creek (UTA), Flat Creek, and Haynes Creek are those listed in the WQS for Gulf Coastal Plain streams with watersheds less than 10 square miles. The designated uses are listed below. They are as follows:

UTB-Unnamed tributary to unnamed tributary to Flat Creek (above Hwy 7S)

- Secondary Contact Recreation,
- Seasonal Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

UTA-Unnamed tributary to Flat Creek (below Hwy 7S)

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Perennial Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Flat Creek

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Perennial Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Haynes Creek

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Perennial Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

3.3 Domestic Water Supply Use

Based upon the anticipated documentation provided by the Arkansas Department of Health (ADHHS), UTB, UTA, Flat Creek, and Haynes Creek are neither an existing nor planned public water supply source. In addition, the Arkansas Department of Natural Resources (ADNR) has documented that the removal of the designated domestic water supply use from these stream reaches does not conflict with the Arkansas Water Plan. Letters requesting the current and anticipated domestic water supply use status have been submitted to the respective agencies. The letters to and from the ADHHS and ADNR are and will be provided in Appendix B.

3.4 Outfall 001 Characteristics

3.4.1. Discharge Characteristics

Figure 3.2 (and Appendix C) provides a summary of the discharge flow characteristics for Outfall 001 over the recent 46 month period. Outfall 001 has not discharged continually during this period. The discharge from Outfall 001 is typically reduced during the summer low flow period.

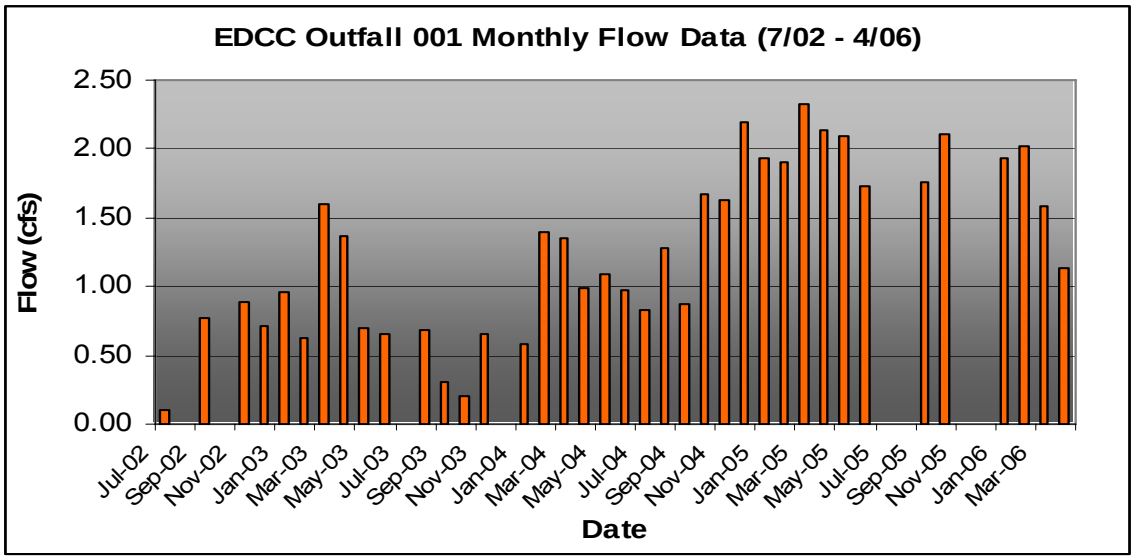

Figure 3.2. Outfall 001 discharge characteristics from EDCC (POR: 46 months).

3.4.2 Effluent Dissolved Mineral Characteristics

Table 3.1 presents the effluent characteristics of treated wastewater discharged through Outfall 001. This data represents available recent data. Documentation for the 95th percentile value is presented in Section 5.0. The percentile concentration values represent statistically calculated values based on methodologies outlined in *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987) which will be discussed in detail in Section 5.2.2.

Table 3.1. Summary of targeted mineral constituents in Outfall 001 discharge from EDCC facility.

Statistic*	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
(Data Characterization)	N=19	N=43	N=19
Maximum	54.0	408	1200
Minimum	27.0	71.0	510
Average	41.0	197	875
95th percentile	55.0	309	1170
Median	43.0	188	890

3.5 Description of Pollution Prevention Practices

Areas where storm water and/or spills may leave the facility are identified in the facility's Spill Prevention Control and Countermeasures (SPCC) Plan and Storm Water Pollution Prevention Plans. These plans are currently being revised to update the individual plans to include recent site improvements. The SWPPP revision is scheduled for completion during the last summer/early fall of 2006 in accordance with the current NPDES permit requirements. The SPCC plan was last revised in 2002 (GBMc, 2002) and is required to be updated every 5 years, at a minimum. EDCC has initiated the SPCC revision ahead of regulatory schedule to incorporate the recent facility improvements. This revision should be completed and implemented by the end of 2006.

Best Management Practices (BMP's) as well as other secondary containment and treatments have been implemented to reduce contamination of storm water and prevent spill release. The SPCC and SWPPP provide the policies and procedures to limit storm water exposure to process waters and provides for the routine management of storm waters. EDCC has installed pollution prevention practices at the facility designed to reduce the potential of storm water contamination and to prevent spills from entering waters of the state.

EDCC currently discharges treated process wastewater and storm water through Outfall 001 into the UTB tributary. Within the last two year period, EDCC has implemented production modifications in response to energy conservation goals, process optimization and environmental control projects in an effort to reduce contaminant levels in the facility's storm water and process waste water as discharged through Outfall 001. These efforts have resulted in the reductions demonstrated over the recent history, especially for SO_4 and TDS (Figures 3.3 and 3.4)

EDCC continues investigating alternatives to the continued discharge of the treated process wastewater and contaminated storm water into the UTB tributary.

3.5.1 Outfall 001

Surface drainage and a storm water sewer system collect storm water and process water from the production of nitric acid, sulfuric acid, and ammonium nitrate (AN) from the Outfall 001 drainage area. The production process requires approximately 1.9 million gallons of process water per day, which is used for cooling tower make-up, hydrostatic testing, pump seal flushing, boiler feed water, and unit wash downs. The storm water and process water are directed through a neutralization treatment system, a one acre aeration basin, and then through a 50-acre equalization basin where additional aggressive biological treatment is carried out. Additionally, improvements of BMPs for storm water treatment have reduced the possibility of contaminated storm water reaching the treatment system. BMPs include: good housekeeping, strict controls on treatment chemicals, policies for storage, spill control, waste minimization, and clean up of wastewater treatment chemicals.

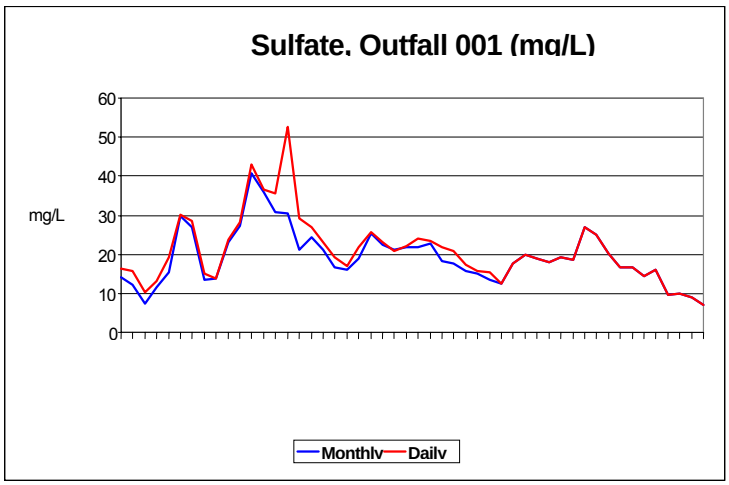

Figure 3.3 Monthly sulfate concentrations in 001 effluent. POR 4/01 to 6/06

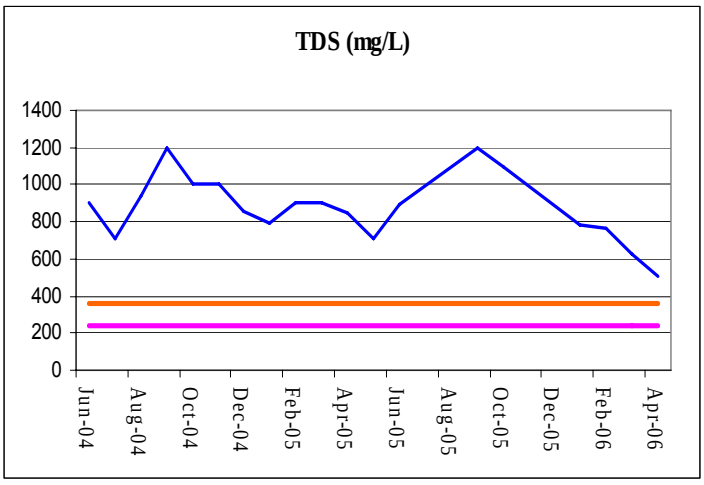

Figure 3.4 TDS concentrations and final permit limits for 001 effluent. POR 6/04 to 4/06

3.6 Current NPDES Permit Status

3.6.1 NPDES Permit Compliance

EDCC's current NPDES permit (Permit No. AR0000752) became effective on July 1, 2002. The permit remains in effect until midnight, June 30, 2007.

3.6.1.1 Discharge and Monitoring Requirements

EDCC is currently under interim effluent limitations at Outfall 001. Chloride (Cl^-), Sulfate (SO_4) and Total Dissolved Solids (TDS) fall under monitor and report limitations until the final permit limitations take effect June 1st, 2007. However, the potential for mineral concentrations to exceed ecoregion instream WQS in Unnamed tributary to the unnamed tributary to Flat Creek (UTB), Unnamed tributary to Flat Creek (UTA), Flat Creek, and Haynes Creek is possible during normal discharge operations through Outfall 001. The instream dissolved minerals WQS in UTB, UTA, Flat Creek, and Haynes Creek are based on the maintenance of the designated, but non-existing and unattainable domestic water supply use. The final discharge limitations and monitoring requirements for EDCC's Outfall 001 are summarized in Table 3.2.

Table 3.2. Current Final Discharge Limitations for EDCC, Outfall 001.

Effluent Characteristic	Monthly Average	Daily Maximum	Monthly Average	Daily Maximum	Frequency of Analysis
Flow (MGD)	N/A	NA	NA	NA	Daily*
Total Suspended Solids (TSS)	462 lbs/day	692 lbs/day	30 mg/L	45 mg/L	three/week
Ammonia Nitrogen (NH_3-N)	265.7 lbs/day	811.84 lbs/day	12 mg/L	18 mg/L	three/week
Nitrate Nitrogen (NO_3)	405.02 lbs/day	1153.73 lbs/day	26.3 mg/L	74.9 mg/L	three/week
Dissolved Oxygen (May - Oct.) (Nov. – April)	 N/A N/A	 N/A N/A	 4.0 mg/L inst. Min 5.0 mg/L inst. Min		 three/week three/week
Copper, Total	0.19 lbs/day	0.38 lbs/day	12.2 µg/L	24.48 µg/L	once/month
Selenium, Total	0.09 lbs/day	0.17 lbs/day	5.58 µg/L	11.2 µg/L	once/month
Zinc, Total	1.78 lbs/day	3.57 lbs/day	115.62 µg/L	231.99 µg/L	once/month
Sulfate (SO_4)	Report	Report	81 mg/L	122 mg/L	once/month
Chlorides (Cl)	Report	Report	38 mg/L	57 mg/L	once/month
Total Dissolved Solids (TDS)	Report	Report	237 mg/L	356 mg/L	once/month
Temperature	NA	NA	NA	86 °F inst. Max	once/month
pH (SU)	N/A	NA	*	*	continuous
Whole Effluent Toxicity	not < 100% (Daily Average Minimum)		not < 100% (7-Day Minimum)		once/month
** pH shall not be less than 6.0 standard units nor greater that 9.0 standard units					

3.6.1.2 Dissolved Minerals

Dissolved minerals data from Outfall 001 (Cl^-, SO_4, and TDS) has been collected and monitored monthly since June, 2004 (Cl^- and TDS), and well beyond that for SO_4. Table 3.3 summarizes the dissolved mineral concentration typical of a discharge from EDCC Outfall 001. Additional chloride, sulfate and TDS information is provided in Section 5.0. Outfall 001 dissolved mineral concentrations were used in the mass balance modeling to determine the proposed instream criteria.

Table 3.3. Summary of dissolved mineral data from EDCC Outfall 001.

Date	Chloride Monthly Average (mg/L)	Sulfate Monthly Average (mg/L)	TDS Monthly Average (mg/L)
Jan-02	--	136	--
Feb-02	--	137	--
Mar-02	ND	ND	ND
Apr-02	--	232	--
May-02	--	272	--
Jun-02	--	408	--
Jul-02	--	359	--
Aug-02	ND	ND	ND
Sep-02	--	309	--
Oct-02	ND	ND	ND
Nov-02	--	306	--
Dec-02	--	213	--
Jan-03	--	245	--
Feb-03	--	213	--
Mar-03	--	166	--
Apr-03	--	160	--
May-03	--	189	--
Jun-03	--	252	--
Jul-03	ND	ND	ND
Aug-03	--	226	--
Sep-03	--	213	--
Oct-03	--	218	--
Nov-03	--	219	--
Dec-03	ND	ND	ND
Jan-04	--	229	--
Feb-04	--	184	--
Mar-04	--	176	--
Apr-04	--	158	--
May-04	--	150	--
Jun-04	40.2	134.5	900
Jul-04	34.4	125	710
Aug-04	48.4	178	940
Sep-04	51.6	200	1200
Oct-04	50.8	188	1000
Nov-04	44.2	179	1000
Dec-04	32.2	193	860
Jan-05	30.2	187	790
Feb-05	27	268	900

Table 3.3 (cont'). Summary of dissolved mineral data from EDCC Outfall 001.

Date	Chloride Monthly Average (mg/L)	Sulfate Monthly Average (mg/L)	TDS Monthly Average (mg/L)
Apr-05	32.1	203	850
May-05	29.2	166	710
Jun-05	42.8	167	890
Jul-05	ND	ND	ND
Aug-05	ND	ND	ND
Sep-05	46.2	143	1200
Oct-05	47.6	160	1100
Nov-05	ND	ND	ND
Dec-05	ND	ND	ND
Jan-06	46.5	97	780
Feb-06	47.2	99.2	760
Mar-06	53.6	90.4	630
Apr-06	38.8	70.7	510
Summary Statistics			
Maximum	54.0	408	1200
Minimum	27.0	71.0	510
Average	41.0	197	875
95th percentile*	55.0	309	1170
Median	43.0	188	890

- * See Section 5.0
- Note: ND = No Discharge

As indicated in Table 3.3 (Summary of dissolved mineral data from EDCC Outfall 001), there were no permit requirements to monitor and report chloride or TDS until June 2004.

3.6.2 Whole Effluent Toxicity (WET) Testing

Toxicity testing has been conducted on EDCC's primary discharge (Outfall 001) for over 10 years. During the previous permit cycle the whole effluent toxicity testing was required on a quarterly basis. Since the most recent permit renewal, the WET testing is required monthly. The interim requirement is a monitor and report only requirement. When the final permit limit becomes effective (June 1, 2007), the WET becomes a permit limit rather than a monitor and report requirement.

The most recent biomonitoring history demonstrates that the treated effluent is not toxic even under the critical dilutions reflective of critical Q 7-10 flow concentrations (e.g. 100% critical dilution). A summary of the last five year period of record for the biomonitoring is provided in Appendix D-1. The summary demonstrates that EDCC Outfall 001 currently passes both the lethality endpoints at the applicable critical dilution (100%). Although there have been issues with toxicity testing history, monthly testing since April 2005 have passed all WET test lethality endpoints, on both the water flea and fathead minnow. The record for no lethality effects to the water flea dates back to September 2004 without any test failures (Figure 3.5).

Figure 3.6 further illustrates the improved performance in WET testing. The sub-lethal endpoints (e.g. reproduction and growth, for the water flea and the fathead minnow, respectively) also demonstrate compliance with the critical dilutions the majority of the time since early 2005.

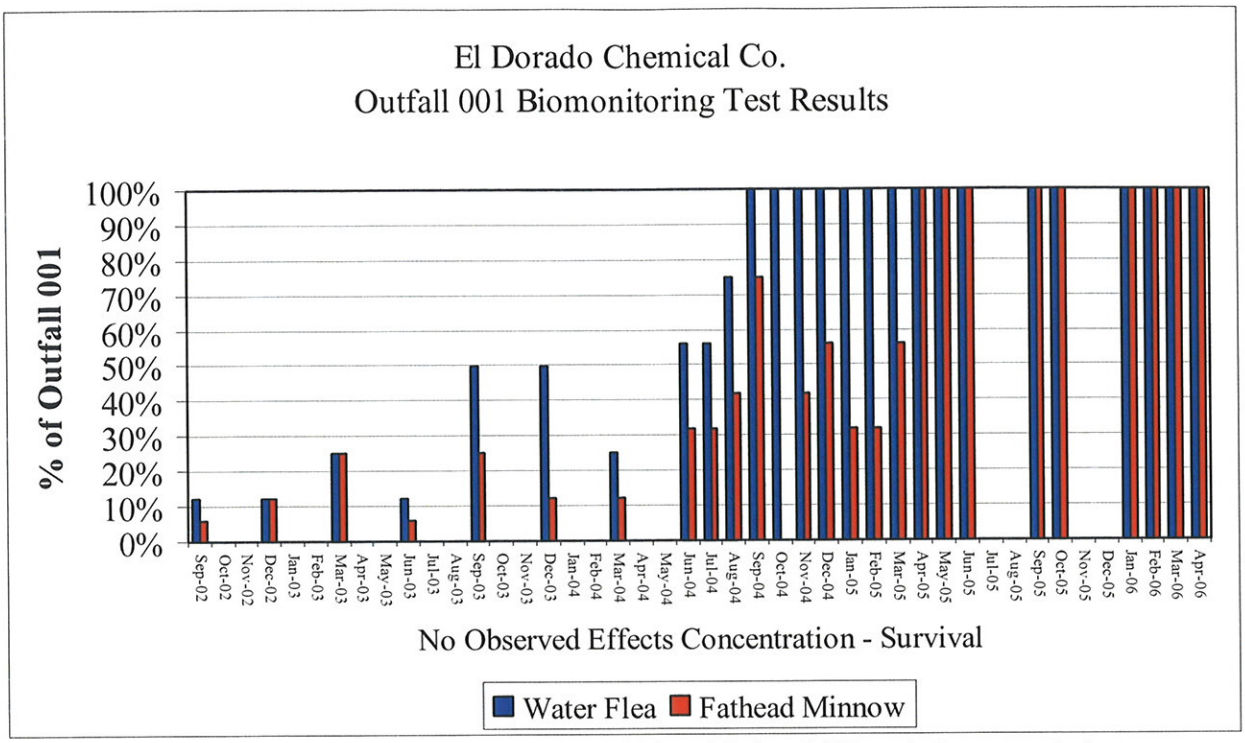

Figure 3.5 Summary of water flea (*Ceriodaphnia dubia*) and fathead (*Pimephales promelas*) biomonitoring performance. Period of record September 2002-April 2006. Note : Quarterly monitoring before June 2004, monthly thereafter. No discharge during July-August and November –December 2005.

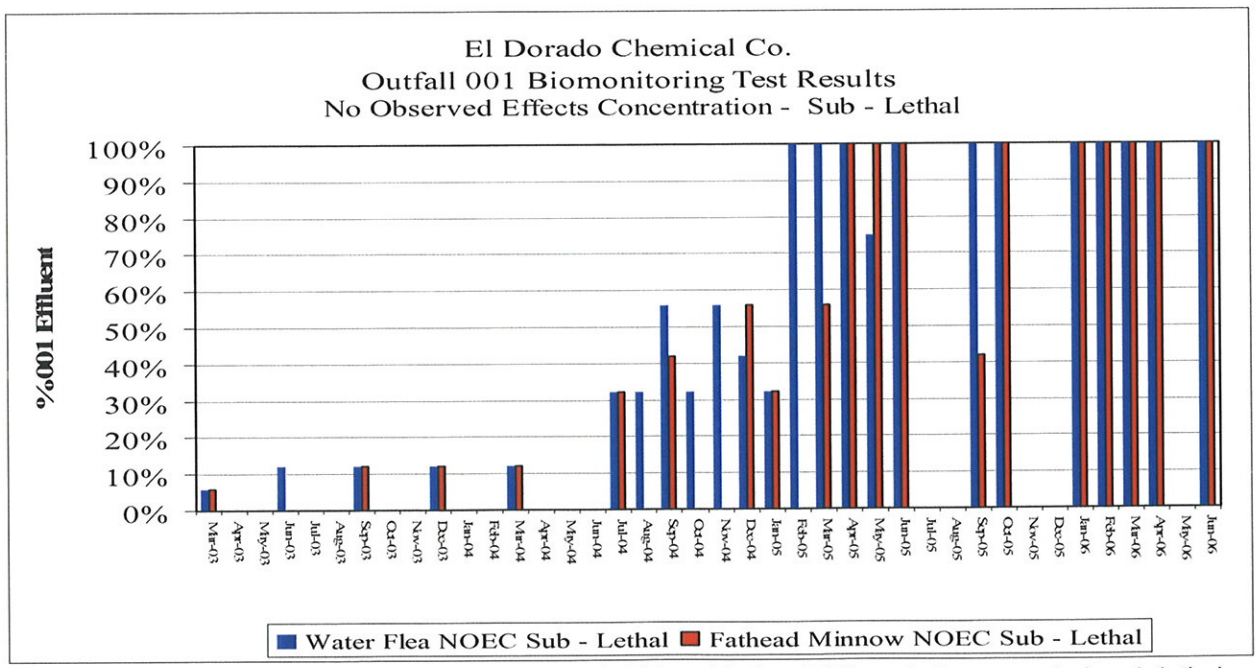

Figure 3.6 Summary of water flea (*Ceriodaphnia dubia*) and fathead (*Pimephales promelas*) sub-lethal WET tests performance. Period of record September 2002-April 2006. Note : Quarterly monitoring before June 2004, monthly thereafter. No discharge during July-August and November –December 2005.

The recent improvements to the waste water treatment process, increased production process controls, and improvements related to other BMP activities (including increased attention to spill prevention, control, and countermeasures; and containment to prevent exposure) are reflected in the improvements to the WET testing results. Figures 3.5 and 3.6 demonstrate the benefits of improved treatment and process modifications by the reduced variability in the chronic biomonitoring results.

Prior to April 2005, the biomonitoring history for EDCC indicated significant differences at concentrations less than 100% effluent. However, a more detailed review of the test results (Appendix D) indicates that the dissolved mineral concentration of the Outfall 001 effluent, as indicated by the effluent conductivity, was not likely responsible for the results demonstrated in the biomonitoring.

Although storm water discharges are also monitored during discharge events, ongoing site modifications and facility improvements will ultimately eliminate the discharge from storm water outfalls. The current plans call for the routing of all facility storm water into the current collection and treatment system with ultimate discharge through Outfall 001. The plans for site storm water management should be fully implemented by June 2007.

4.0 AQUATIC LIFE FIELD STUDY

4.1 Introduction

The objective of the aquatic life field study was to document whether the designated aquatic life use was being maintained in unnamed tributaries to Flat Creek and if the permitted discharges from EDCC are beneficial or detrimental to the maintenance of those uses.

To accomplish the study objective, the aquatic life field study included evaluations of the habitat conditions, water quality, aquatic macroinvertebrate community, and fish community assemblages. Studies reaches for the aquatic life field study are as follows:

- Reach UTC1: the unnamed tributary to Flat Creek upstream of any EDCC influence (reference site),
- Reach UTB1: the unnamed tributary to Flat Creek above the confluence with UTC watershed but below Outfall 001 (the primary discharge) and other inactive but permitted discharges (002, 004, 006/007);
- Reach UTB2: the unnamed tributary combining UTC and UTB watersheds (size approximately 2.37square. miles)
- Reach UTA1: the unnamed tributary to Flat Creek above any influence with discharge from EDCC.
- Reach UTA2: The unnamed tributary to Flat Creek downstream of Hwy 7S and the confluence with UTB (includes discharge from EDCC);
- Reach UTA3: The unnamed tributary to Flat Creek at O'Rear Road;
- Reach FC1: Flat Creek upstream of Hwy 167. Site is reference reach for UTA1; and
- Reach FC2: Flat Creek at O'Rear Road, site served as reference reach for UTA3. Figure 3.1

As indicated above several study reaches were also characterized by ADEQ in the 1996 TMDL report. The size of each watershed of unnamed tributary to Flat Creek at each study reach is provided in Table 4.1.

Table 4.1. Watershed size at each study reach evaluated during the EDCC aquatic life field study. Union County. April 2006.

Study Reach	Watershed Size, square. miles
UTC	1.15
UTB1	1.17
UTB2	2.37
UTA1	6.0
UTA2	11.14
UTA3	15.83
FC1	9.68
FC2	11.63

A summary of the aquatic life field study is presented in the following report sections. Appendix E provides the field data sheets, habitat characterization data sheets, analytical results, benthic field and tally sheets, and fish collection field and tally sheets. Appendix F provides the photographic documentation of the seasonal and low flow conditions.

4.2 Habitat Characterization

4.2.1 Introduction

Physical habitat in streams includes all those physical attributes that influence or provide sustenance to biological attributes, both botanical and zoological, within the stream. Stream physical habitat varies naturally, as do biological characteristics; thus, habitat conditions differ even in the absence of point and anthropogenic non-point disturbance. Within a given ecoregion, stream drainage area, stream gradient and the geology are likely to be strong natural determinants of many aspects of stream habitat, because of their influence on discharge, flood stage, and stream energy (both static and kinetic). Kaufmann (1993) identified seven general physical habitat attributes important in influencing stream ecology and the maintenance of biological integrity:

1) channel dimensions,
2) channel gradient,
3) channel substrate size and type,
4) habitat complexity and cover,
5) riparian vegetation cover and structure,
6) anthropogenic alterations, and
7) channel-riparian interaction.

Land use activities can directly or indirectly alter any and/or all of these attributes. Nevertheless, the trends for each attribute will naturally vary with stream size (drainage area) and overall gradient. The relationships of specific physical habitat measurements described in this section to these seven attributes are discussed by Kaufmann (1993). Although they are actually biological measures, aquatic macrophytes, riparian vegetation, instream habitat and canopy cover are included in this and other physical habitat assessments because of their role in habitat structure and light inputs. The objectives of a habitat characterization are to:

1) assess the availability and quality of habitat for the development and maintenance of benthic invertebrate and fish communities, and
2) evaluate the role of habitat quality in relation to the attainment of designated uses and biological integrity.

There are three main headings for the components of the physical habitat characterization each with several categories. Measurements for each of the components (14 categories total) are recorded on copies of a two-page field form entitled Stream Habitat Assessment (Semi-Quantitative), and include:

1) Channel Morphology
   a) Reach Length Determination,
   b) Riffle-Pool Sequence, and
   c) Depth and Width Regime

2) Instream Structure
   a) Epifaunal Substrate,
   b) Instream Habitat,
   c) Substrate Characterization,
   d) Sediment Deposition, and
   e) Aquatic Macrophytes and Periphyton

3) Riparian Characteristics
   a) Canopy Cover,
   b) Bank Stability and Slope,
   c) Vegetative Protection, and
   d) Riparian Vegetative Zone Width.

Field physical habitat measurements from a field habitat characterization are used in conjunction with water chemistry, temperature, macroinvertebrate and vertebrate (typically fish) community analyses, and other data sources to determine the status of the target streams attainment of designated uses and the water quality required to maintain those uses.

These procedures are intended for evaluating physical habitat in wadeable streams, but may be adapted for use in larger streams as necessary. The field procedures applied to this characterization are most efficiently applied during low flow conditions and during times when terrestrial vegetation is active, but can also be applied during spring seasonal conditions with higher base flows. This collection of procedures is designed for monitoring applications where robust, quantitative or semi-quantitative descriptions of habitat are desired. This semi-quantitative habitat procedure is usually used in conjunction with the *General Physical Habitat Characterization* and the *Qualitative Habitat Assessment* to provide a detailed view of the streams habitat condition.

The habitat characterization protocol provided herein differs from other rapid habitat assessment approaches (e.g., Plafkin et al., 1989, Rankin, 1995) by employing a systematic spatial sampling that minimizes bias in the placement and positioning of measurements. Measures are taken over defined channel areas and these sampling areas are placed systematically at spacing that is proportional to the length of the entire study reach. This systematic sampling design provides resolution appropriate to the length of the study reach. The habitat assessment protocol summarized in this SOP is based on those of USEPA in their EMAP and RBP procedures (Lazorchak, 1998 and Barbour, 1999), USGS NAWQA program (Fitzpatrick, 1998) and Missouri Department of Natural Resources ESP (Sarver, 2000).

The procedures are employed on a sampling reach of length equal to 20 times the bankfull width. The semi-quantitative habitat sampling reach length should coincide as much as possible with that of the fish and macroinvertebrate collection reaches. Measurements are taken in each of 10 sub-reaches, which are systematically placed at intervals equal to approximately one tenth (1/10) the length of the represented study reach. Measurements and observations for each habitat characteristic are made in each of the sub-reaches as the assessment team moves along the stream channel. An average or total of the scores for each of the 10 sub-reaches is then calculated resulting in a mean value for each characteristic for the entire reach.

4.2.2 Methods

The habitat assessment was conducted within (or to the extent possible) the stream reach from which the benthic and fish communities are to be characterized. The physical habitat was characterized from measurements and observations of stream attributes made within 10 sub-reaches. The team assessing habitat moved along the stream channel (near the thalwag) observing habitat characteristics within each sub-reach. A description of and the rationale for measuring each of the attributes are provided below. The details of how these attributes are recorded/evaluated are also described below in the following sections.

4.2.2.1 Channel Morphology

Channel morphology (or geomorphology) is a characterization of the shape of the stream channel including measurements and/or visual estimates of channel dimensions and riffle-pool sequences (i.e. a measure of the amount of riffles, runs and pools that occur in a given reach).

The channel observed includes that portion of the stream between the base flow wetted area and the top of the normal high water channel often referred to as the bankfull stage (Figure 4.1). The "bankfull" or "active" channel is defined as the channel that is filled by moderate-sized flood events that typically occur every one or two years. Such flow levels are on the verge of entering the flood plain and are believed to control channel dimensions in most streams.

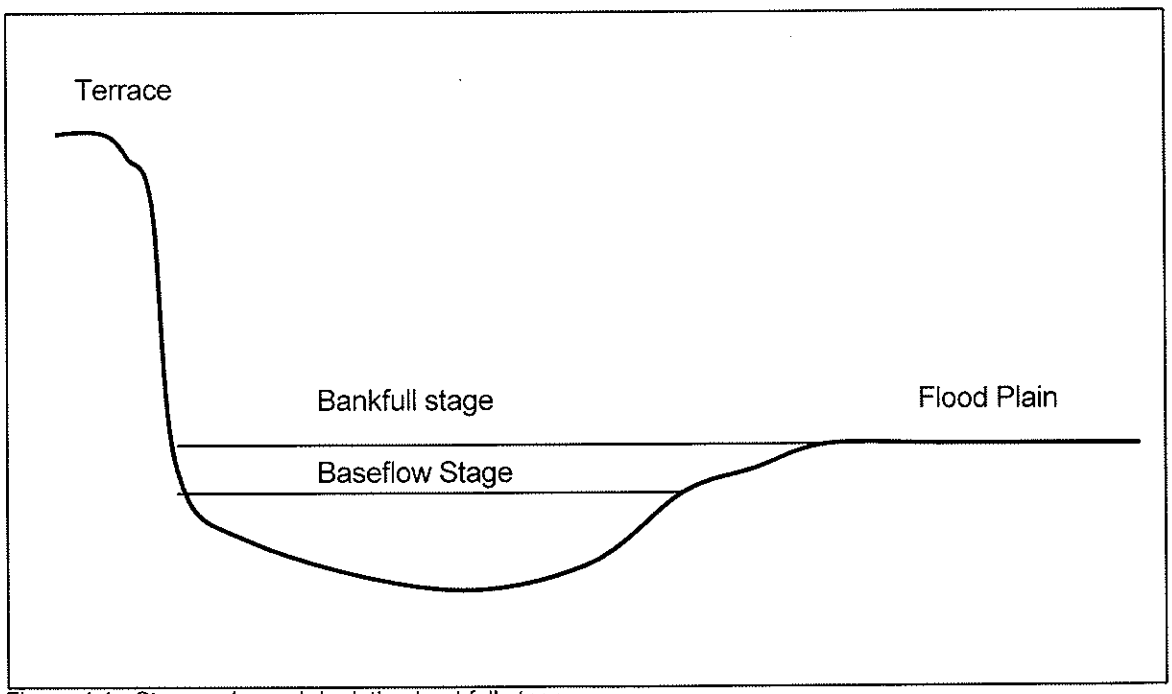

Figure 4.1. Stream channel depicting bankfull stage.

1) Reach Length Determination

First, bankfull depth (depth from stream bottom in thalwag to bankfull stage on the bank) was identified in at least two separate riffles (or alternatively runs in streams not exhibiting riffle morphology) in each study reach. Then bankfull depth and width was determined from 5 stream transects and recorded on the record sheet. Transect locations was selected to include each prominent morphology type represented in the stream. Bankfull depths were measured to the nearest 1/10 foot and bankfull widths were measured to the nearest foot using a wading rod and tape measure, respectively. An average of the 5 bankfull widths was then calculated and multiplied times 20 to arrive at the total reach length for assessment. This total length was then divided by ten to determine the length of each of the ten sub-reaches. Analysis of the first sub-reach began at the head of a given stream morphology (i.e. riffle, run or pool).

2) Riffle-Pool Sequence

Stream morphology refers to the abundance and placement (sequencing) of riffles, runs, and pools in a stream system. This sequencing is an indicator of a streams hydrological regime and stability as well as a determinant of its potential to sustain diverse aquatic communities. Beginning at the head of a morphological type (riffle, run or pool) the length of each morphological type in the stream reach was measured using a tape measure and recorded on the record sheet. The sequence of each morphological type was depicted on the record sheet using the provided notations so as to create a map to the location of each riffle, run or pool. The resulting measurements provided a quantitative measure of the percent of the study reach representing each stream morphological type (i.e. 40% riffle, 30% run, 30% pool, etc).

3) Depth and Width Regime

The average stream depth and width were estimated in riffles and pools in each sub-reach. Depths were measured along a transect, similar to that depicted in Figure 4.2, in a representative section of each riffle and pool in the sub-reach. Depths were generally taken in the thalwag (deepest area in stream channel) and approximately half way between the thalwag and the left and right banks. An estimated average depth for riffles and pools occurring in a sub-reach was derived from the cross-sectional depth measurements and recorded on the record sheet to the nearest 1/10 foot. Once completed for all 10 sub-reaches this provided an accurate semi-quantitative measurements of riffle and pool average depth and depth variability across the entire stream reach.

Stream wetted widths were measured along a transect, in a representative section of each riffle and pool in the sub-reach. An estimated average width for each morphological type in a sub-reach was recorded on the record sheet to the nearest foot. Once completed for all 10 sub-reaches this provided accurate semi-quantitative measurements of riffle and pool widths across the entire stream reach.

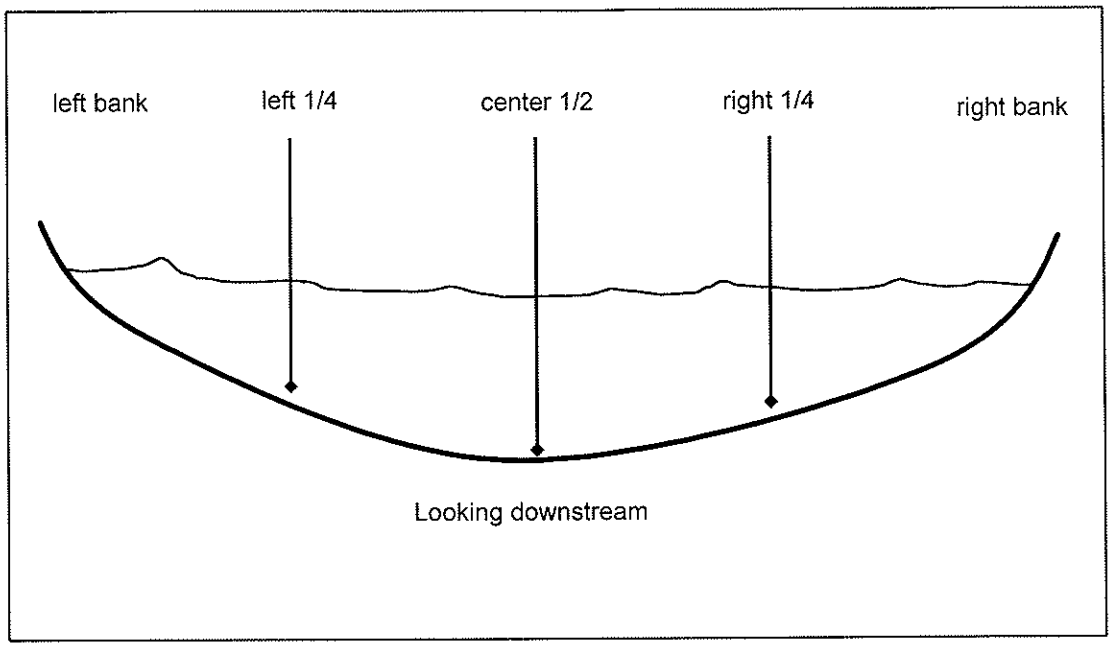

Figure 4.2. Approximate position of measurements across transect.

4.2.2.2 Instream Structure

Instream structure describes the characteristics of the stream within the wetted perimeter that makes up the habitat suitable for colonization of aquatic biota. This includes information about natural substrates (gravel, boulders, etc), aquatic plants and algae and debris that has been washed into or fallen into the stream, such as logs, leaves, etc. A stream capable of sustaining diverse aquatic communities will contain a variety of instream structure including some that is permanent and some that is mobile during high flow events.

1) Epifaunal Substrate (Macroinvertebrates)

   Epifaunal substrate refers to the area on the bottom of the stream (entire wetted perimeter) where macroinvertebrates inhabit. This attribute is scored as a percentage of the stream bottom in a sub-reach which contains substrates suitable for macroinvertebrate colonization. Scoring for this attribute should rely heavily on the stability of the substrate, the size of the interstitial spaces, and the cleanliness (not covered in thick algae or sediment deposits) of the substrate. Cobbles and coarse gravel will score higher percentages as they contain larger interstitial spaces for colonization, while sand and silt would score lower since they provide little spaces. In addition, root wads along the bank would score higher as they are more stable features than would depositional areas or small woody debris.

2) Instream Habitat (Fish)

   Instream habitat refers to the habitat features within the wetted perimeter of the stream sub-reach which are available for fish colonization. This attribute is scored as the percentage of the stream bottom (wetted perimeter) in a sub-reach which is covered with fish habitat. As with the epifaunal substrate attribute substrates composed of

cobbles, coarse gravels and boulders score higher for fish cover as they provide better spaces for colonization. Other habitats that score high are large woody debris (individual logs with diameter >4 inches or complex woody structures composed of rootwads, logs, or limbs with diameter of 1.5 ft. or greater) and undercut banks. While habitats that score lower are those such as depositional areas, leaf packs, and fine sediments or sand.

3) Substrate Characterization

The dominant stream substrate size classification for riffles and pools within each sub-reach will be recorded on the record sheet. Only substrates within the wetted perimeter are evaluated. This information will be used to characterize the similarities and or differences in substrate structure and complexity in the riffles and pools of the study reach as it relates to the development and maintenance of the systems biological integrity.

Particle are classified into one of the size classes listed on the Semi-Quantitative Habitat Assessment Field Form based on the size of the intermediate axis (median dimension) of its length, width, and depth. This "median" dimension is the sieve size through which the particle can pass.

i. Bedrock	smooth or rough
ii. Boulder	>25 cm
iii. Cobble	6-25 cm
iv. Coarse Gravel	1.6 – 6 cm
v. Fine Gravel	0.2 – 1.6 cm
vi. Sand	<0.2 cm
vii. Silt/Mud/Clay	fine, not gritty

Notations are made for unusual substrates such as concrete or asphalt and denote these artificial substrates as "other" and describe them in the comments section of the field data form. Code and describe other artificial (such as large appliances, tires, car bodies, etc.) substrates in the same manner.

4) Sediment Deposition

The sediment deposition attribute refers to the amount of stream bottom (in the wetted perimeter) that is covered by fine sediments and/or particulate organic matter. This attribute is scored as a percentage of the bottom in each sub-reach which is covered by such loose materials.

5) Aquatic Macrophytes and Periphyton Coverage

An estimate of the percentage of area covered by macrophytes and periphyton in a sub-reach is made and recorded both for riffles and pools. Macrophytes refers to aquatic plants that grow in the stream (both emergent and submerged), and periphyton refers to algae that grows on fixed surfaces. This attribute helps biologists determine stream productivity from a nutrient enrichment perspective and also for the availability of food sources for aquatic biota.

4.2.2.3 Riparian Characteristics

The riparian area includes the area from the stream bank in a direction away from the stream into the upland areas. It is these streamside riparian zones that ultimately help shape the stream and provide organic material as nutrients to the aquatic system. A well developed riparian area protects stream banks from erosion, provides shading, inputs nutrients, provides materials as habitat (instream structure) and filters runoff entering the stream. In the absence of well developed riparian zones the stream is more impacted by encroaching land-uses.

1) Canopy Cover

Canopy cover (percent stream shading) over the stream was determined for each of the sub-reaches. Estimates of cover are made by looking into the canopy over the stream channel. Estimates were made from mid-channel and each quarter channel to determine the average percent canopy cover for the width of the stream in the sub-reach. Percent canopy at each measurement point was estimated visually.

2) Bank Stability and Slope

Bank stability is an important attribute that is an indication of a stream reach's overall hydrologic equilibrium. A bank's stability also determines its ability to provide stable habitat for biota and its propensity to release large sediment yields to the stream, which ultimately cause high turbidity and deposition in downstream reaches. The right and left banks are classified according to the following categories:

Score 9-10 = Stable, little evidence of erosion, < 5% bank eroding
Score 6-8 = Moderately stable, some evidence of new erosion, 5-29% bank eroding
Score 3-5 = Moderately unstable, obvious new erosion, 30-59% bank eroding
Score 1-2 = Unstable, most of bank actively eroding, 60-100% bank eroding

Banks composed of sands and gravels are much less stable than banks composed of silt/mud/clay or cobbles. The density of well rooted (more permanent) vegetation and root structure also help to improve a banks stability.

Average bank slope (in degrees) in a sub-reach, was recorded for each bank (left and right). Bank slope affects the stability of a bank and is an indicator of past erosion. A gentle slope may average 30° while a steep or undercut bank may average 90° or 100°, respectively.

3) Vegetative Protection

Bank vegetative protection was measured as a percent of the bank surface area which is covered by stable riparian vegetation and their associated roots in a sub-reach. Each bank (right and left) was assessed separately and the value recorded on the record sheet. Banks were assessed from the edge of the water to the top of the first terrace or normal top of bank.

4) Riparian Vegetative Zone Width

Riparian zone encompasses the area from the top of the normal stream bank outwards into the upland area. The broader the riparian vegetative zone width the more protected the stream banks are from alteration, the fewer pollutants will enter the stream from runoff, and the more available food sources there are to be deposited into the stream from the surrounding forest. Riparian zone width is scored for each bank in a sub-reach according to the following scale:

Score 9-10 = Riparian Zone Width > 18 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 1-2 = Riparian Zone Width < 6 meters

4.2.3 Scoring and Analysis of Habitat Assessment Data

Scores from the Semi-Quantitative Habitat Assessment was utilized in two different ways. First, data collected for each attribute (assessment category) was used independently to describe the study reach collectively. This method results in information such as: average riffle depth, average pool width, % riffle in entire reach, average bank stability, average (median) substrate size class in pools and riffles, mean % canopy cover, etc. Second, the data collected during the assessment was used in conjunction with the Qualitative Habitat Assessment procedure to score each of the ten "qualitative" indices with near quantitative accuracy (semi-quantitative). A combination of the two methodologies was incorporated into this intensive aquatic biota field study. The following sections outline the scoring of the qualitative habitat indices using the semi-quantitative data.

1) Epifaunal Substrate/Available Fish Cover

Average values from semi-quantitative categories 4 (Epifaunal Substrate) and 5 (Instream habitat) are combined into an overall average percent coverage and used to score this metric.

The following table presents the scoring criteria:

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Coverage	>70%	40%-70%	20%-39%	<20%
Score	20 -16	15 -11	10 - 6	5 - 1

2) Pool Substrate Characterization

Using the Substrate Characterization data from the semi-quantitative assessment (category 6) and the aquatic vegetation assessment (category 9) the following table may be used to score this metric.

Rank	Optimal		Sub-Optimal	Marginal	Poor
Substrate	Cobble or Gravel		Sand/Silt/Clay	Sand/Silt/Clay	Bedrock or Clay Only
Macrophytes Present	Yes	No	Yes	No	No
Score	20 - 18	17 - 16	15 - 11	10 - 6	5 - 1

3) Pool Variability

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) are used to help score this metric. Use the following table to determine pool variability.

Pool Characteristic	Large-Deep	Large-Shallow	Small-Deep	Small-Shallow
Size	Length ≥ Width	Length ≥ Width	Length < Width	Length < Width
Depth	≥3.2 feet	< 3.2 feet	≥3.2 feet	< 3.2 feet

An equal balance of all four pool types achieves higher scores. A prevalence of shallow pools scores lower.

4) Channel Alteration

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

5) Sediment Deposition

Reach average percent bottom affected by deposition (from category 8) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Bottom Affected	<5%	5%-30%	31%-50%	>50%
Score	20 -16	15 -11	10 - 6	5 - 1

Utilize the lower end of each scale to represent reaches where recent sediment bar formation is evident.

6) Channel Sinuosity (replacement for Frequency of Riffles)

This metric is assessed separately from the semi-quantitative data. It can be estimated in the field, measured during a longitudinal survey or calculated from current aerial photographs.

7) Channel Flow Status

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

8) Bank Stability

The average bank stability score for each represented bank from the semi-quantitative assessment (category 11) is directly applied to the qualitative assessment scoring for this metric (i.e. an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

9) Vegetative Protection

Reach average percent bank protected (from category 12 of the semi-quantitative record sheet) is used directly to score this metric for the right and left bank.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Protected	>90%	70% - 90%	50% - 69%	<50%
Score	20 -16	15 -11	10 - 6	5 - 1

10) Riparian Vegetative Zone Width

The average riparian zone width score for each represented bank from the semi-quantitative assessment (category 13) is directly applied to the qualitative assessment scoring for this metric (i.e. an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such).

4.2.4 Results and Discussion

4.2.4.1 Habitat Quality

The aquatic life field study was completed during the week of April 17, 2006 during seasonal stream conditions. A summary of the physical attributes of all stations where physical data was collected is presented in Table 4.2. Each study reach was generally characteristic of Gulf Coastal Plain streams and/or seasonal wet-weather tributaries with small watersheds. Field sheets and the raw habitat data are provided in Appendix E. Reach by reach descriptions are presented in the following paragraphs.

4.2.4.2 Reach UTC1

As identified in Section 4.1, Reach UTC1 (watershed size of 1.15 square. miles) was used to represent an upstream reference condition to compare for UTB (watershed of 1.17 square. miles). UTB is the ditch into which Outfall 001 discharges. The upstream terminus of the Reach UTC1 was a point less than 100 yards upstream from the mouth, where no standing water was present for a distance equal to the reach below (approximately 100 yards). Clearly, the small water shed limited biotic community development even during the spring seasonal period. The flow was minimal and estimated at less than 0.01cfs. Although the reach was characterized as 50/50 run/pool, this complex existed only in the reach just above the confluence with UTB. The UTC1 reach differed from the UTB1 reach in three primary characteristics:

- flow 0.01 vs. 2.1 cfs in UTB1,
- run/pool complex, 50/50 vs. 84/16 in UTB and
- the lack of sediment deposition, 25% vs. 48% of stream bottom impacted in UTB1.

These characteristics provided a greater diversity of habitats for the development of the benthic and fish community in Reach UTC1: however, the lack of flow, even during the seasonal period limits the biotic potential and resulted in a reduced benthic diversity and limited fish community development (See Sections 4.4 and 4.5). Although there was minimal flow during the aquatic life field study, it is likely that flows from EDCC influence the lower reaches of UTC1 when a discharge occurs from Outfall 001 and there is no flow in UTC (Appendix F: Photos F1 and F2).

Table 4.2. Summary of habitat characteristics of study reaches during seasonal flow conditions. EDCC aquatic life field survey. Union Co. AR. April 2006.

Observation	Sample Location							
	UTC1	UTB1	UTB2	UTA1	UTA2	UTA3	FC1	FC2
Date	4/20	4/20	4/20	4/18	4/18	4/17	4/19	4/17
General Stream Characteristics:								
Total Habitat Reach Length, ft	144	158	280	400	367	390	518	424
Average Bankfull Width, ft	7.2	7.9	10.4	20	18.3	19.5	25.9	21.2
Average Bankfull Depth, ft[1]	1.15	1.4	1.4	0	1.55	2.1	1.5	2.23
Average Velocity, fps	0.01	0.73	0.49	0	0.63	0.34	0.16	0.12
Flow, cfs	0.01	2.1	1.87	0	4.14	3.47	1.57	1.47
Morphology Regime								
% Riffle	< 1	0	12	0	0	4	27	0
% Run	50	84	59	0	37	45	37	46
% Pool	50	16	29	100	63	50	35	54
Depth and Width Regime								
Average Riffle Depth, ft.	0.2	NA	0.6	0	NA	0.7	0.52	NA
Average Riffle Wetted Width, ft.	1	NA	8.75	0	NA	11	15.6	NA
Average Run Depth, ft.	0.5	1.2	0.83	0	1.44	1.3	0.86	1.6
Average Run Wetted Width, ft.	3.3	5.2	6.5	0	20.4	14.6	11.2	12.8
Average Pool Depth, ft.	0.9	1.2	1.4	3.8	2.19	2.94	2.6	3.3
Average Pool Wetted Width, ft	5.9	6.5	7.63	20.1	21.9	16	20.7	16.4
In-Stream Habitat (Percent Stable Habitat)								
Epifaunal Substrate, Macroinvertebrates	30	38	32	46	34	36	37	37
In-Stream Cover, Fish	34	34	33	57	43	41	40	47
Substrate Characterization (Dominate Substrate)								
Riffle	Silt/Clay	NA	Sand	NA	NA	Sand	Sand	NA
Run	Sand	Sand	Sand	NA	Sand	Sand	Sand	Sand
Pool	Sand	Sand	Sand	Silt/Clay	Sand	Sand	Sand	Silt/Clay
Sediment Deposition								
Average Percent of Bottom Affected	25	48	53	52	58	34	30	37
Aquatic Macrophytes and Periphyton (Percent Coverage)								
Riffle Macrophytes	0	NA	0	NA	NA	0	0	NA
Riffle Periphyton	0	NA	0	NA	NA	0	0	NA
Run Macrophytes	3	3	2	NA	0	0	0	0
Run Periphyton	0	0	0	NA	0	0	0	0
Pool Macrophytes	2	3	1	0	0	0	0	0
Pool Periphyton	0	0	0	5.5	0	0	0	0
Canopy Cover (Percent Stream Shading)								
Stream Shading	27	7	22	39	45	53	52	74
Bank Stability and Slope								
Average Left Bank Stability	8	6	6	7	8	6	7	6
Average Left Bank Slope (degrees)	60	75	57	70	74	64	66	81
Average Right Bank Stability	7	6	7	7	8	6	6	7
Average Right Bank Slope (degrees)	65	79	77	67	84	73	66	83

Table 4.2 (cont).

Bank Vegetative Protection								
Average Left Bank Protection (percent)	51	48	52	59	52	47	41	61
Average Right Bank Protection (percent)	50	54	55	42	46	47	41	60
Riparian Vegetative Zone Width								
Left Bank Riparian Width	5	7	1	9	7	3	5	10
Right Bank Riparian Width	7	7	3	9	10	9	3	10

[1]Average bankfull depth is calculated on riffles only

4.2.4.3 Reach UTB1

This reach is located within the patrolled area of the EDCC facility. The stream course is deeply incised with high stream channels, no over-story canopy, little instream fish habitat and consisted of almost 85% run (reflecting that there is limited substrate and stream morphological variability, no pools and riffle development). The stream morphology reflects the physical impacts of the routine discharge from Outfall 001 and the uniform velocities present when a discharge occurs. However, during periods of no discharge from EDCC, the available habitat was limited by reduced flow and exposed stream channel (Appendix F: Photos F-3-5). The low flow condition that occurs after discharge is eliminated (a seasonal occurrence for Outfall 001 limits the biotic development (Appendix F: Photo F-4 and F-5) (See Section 3.4). The physical stressors in Reach UTB1, which occur during both the spring seasonal period (during the Outfall 001 discharge period) and during the low flow period (the summer with no flow from Outfall 001), combine to limit the biotic development and attainable uses of Reach UTB1. These conditions would indicate that the biotic communities should have been limited when compared to a reference condition and downstream reaches (See Section 4.4 and 4.5).

Average velocity at UTB1 was 0.73 fps, while the flow recorded at this station was 2.1cfs (Appendix D). The reach's substrate was dominated by sand. Heavy amounts of sediments were found with the majority of the bottom sediments impacted (85% of the bottom affected). Stream shading along this reach was sparse (7%) reflecting the historical riparian disruption. Bank vegetative protection was adequate. However, the bank vegetation was predominately grasses, which has very little protective characteristics.

4.2.4.4 Reach UTB2

Reach UTB2 comprises both UTC and UTB watersheds (Figure 4.1). With the increase in watershed size to 2.37 square miles, Reach UTB2 demonstrated a slightly greater degree of stream morphology development and a wider variety and density of instream vegetation than any either of the previous two study reaches. However, the percent of fish cover and macroinvertebrate habitat within this reach was less than at any other study reach, even those with the smallest watersheds. The limited habitat reduces the potential for biotic community development. The stream width and canopy development reflects the doubling of the watershed size. However, the importance of the flow from Outfall 001 in maintaining wetted habitat (and therefore supporting the biotic development potential) is reflected in the difference between the presence and absence of discharge (Appendix F: Photos F-6 and F-7). Reach UTB2 was composed of approximately 59% shallow pools, 29% runs, and approximately 12% riffles (Table 4.2 and Appendix E).

4.2.4.5 Reach UTA1

Reach UTA1 (water shed approximately 6 square miles) is located upstream of the discharge from EDCC but had a watershed almost 3 times that of UTB2 (Figure 2.1). Despite the increased watershed, there was no measurable flow. The reach was comprised of 100% deep pools and was artificially maintained by beaver activity down stream of the study reach. The pool was deep and had areas which could not be assessed without boat access. This reach is atypical of gulf coastal streams with small watersheds. This was the only reach where periphyton growth was recorded. Additional evidence of enrichment was evident by the algae growth along the pool margins (Appendix F Photos F-8 and F-9).

4.2.4.6 Reach UTA2

Reach UTA2 (water shed approximately 11 square miles) is located downstream of the discharge from EDCC (Figure 2.1). The maximum flow recorded during the field survey was recorded at this reach. The reach was comprised of 60/40 mix of pools and runs but the available stream habitat was the smallest recorded from any stream reach except the smallest watersheds. The substrate was dominated by sand which was up to 3 ft deep in some locations (Appendix F: Photos F10-15).

4.2.4.7 Reach UTA3

Reach UTA3 (water shed approximately 15.83 square miles) is located downstream of the discharge from EDCC (Figure 2.1) and just upstream of Flat Creek. The riparian area adjacent to UTA in the reach is predominantly forested. The reach demonstrated a large degree of instream woody habitat development, however, sand and silts dominated the substrate. The reach was comprised with an equal mix of pools and runs. Like the upstream reach, the substrate was dominated by sand which was up to 3 ft deep in some locations. The habitat is sufficient to support the designated fisheries and aquatic life use even during low flow conditions (Appendix F Photos F16-21).

4.2.4.8 Reach FC1

Reach FC1 (water shed approximately 9.68 square miles) is not impacted by the discharge from EDCC. However, the watershed does receive discharge from the City of El Dorado north wastewater ponds and drains the north eastern portion of the City of El Dorado, including the Champagnolle oil and gas fields (Figure 2.1). The reach was comprised with an equal mix of pools, runs, and riffles, the only reach with a large riffle attribute (Appendix F Photos F-22 and F-23). The riparian area adjacent to FC1 in the reach is predominantly forested but is impacted by agricultural uses. The reach demonstrated a large degree of instream woody habitat development, however, sand and silts dominated the substrate. The habitat is sufficient to support the designated fisheries and aquatic life use.

4.2.4.9 Reach FC2

Reach FC2 (water shed approximately 11.63 square miles) is down stream of FC1 and was evaluated for comparison to UTA3 study reach. Like FC1, the watershed does receive discharge from the City of El Dorado north wastewater ponds and drains the north eastern portion of the City of El Dorado, including the Champagnolle oil and gas fields. EDCC (Figure 2.1). The reach was comprised with an equal mix of pools and runs, (Appendix F Photos F.24-26). The riparian area adjacent to FC2 in the reach is predominantly forested. The reach demonstrated a large degree of instream woody habitat development. The habitat is sufficient to support the designated fisheries and aquatic life use.

4.2.5 Habitat Potential

A qualitative assessment of habitat potential was completed at all study reaches. All reaches scored within a narrow range indicating sub-optional, bordering on marginal habitat, for the development and support of expected biotic communities. The assessment placed reaches UTB2, UTA2, and FC1 in the marginal category with mean scores of 10. However, this is at the top end of the category and just under the sub-marginal category where all other reaches were assessed (Table 4.3). Differences in the scores between reaches were demonstrated most significantly by differences in pool variability and channel sinuosity.

The results of the qualitative habitat assessment indicate the presence of habitat for fish and macroinvertebrates at all study reaches. However, none of the reaches were characterized by habitat that would facilitate diverse balanced biotic communities. Based on the assessment of habitat potential, the development of biotic communities would be expected to be less than that typical in least disturbed gulf coastal systems. The individual scoring forms are provided in Appendix E.

Table 4.3 Semi-qualitative assessment of habitat potential. EDCC aquatic life field survey. Union County, AR. April 2006.

Parameters	Reach							
	UTC1	UTB1	UTB2	UTA1	UTA2	UTA3	FC1	FC2
1. Epifaunal Substrate	11	11	11	15	11	12	13	13
2. Pool Substrate	12	11	11	8	9	7	10	10
3. Pool Variability	8	8	8	11	9	16	8	16
4. Channel Alteration	17	11	10	15	11	16	14	18
5. Sediment Deposition	15	11	10	10	7	13	13	13
6. Channel Sinuosity	11	11	13	12	4	9	10	14
7. Channel Flow Status	7	17	15	19	13	17	9	17
8. Bank Stability								
Left Bank	8	6	6	7	8	6	7	6
Right Bank	7	6	7	7	8	6	6	7
9. Vegetative Protection								
Left Bank	3	2	3	7	3	2	2	4
Right Bank	3	3	3	4	2	2	2	4

10. Riparian Vegetative Zone Width								
Left Bank	5	7	1	9	7	3	5	10
Right Bank	7	7	3	9	10	9	3	10
Score (Total)	114	111	101	133	102	118	102	142
Score Average	11	11	10	13	10	12	10	14
Ranking	S	S	M	S	M	S	M	S
Ranking	**Range**							
Optimal (O)	16-20							
Sub-optimal (S)	11-15							
Marginal (M)	6-10							
Poor (P)	0-5							

4.2.6 Habitat Conclusions

The habitat evaluation indicates that:

1. The habitat of the unnamed tributaries to Flat Creek provides some marginal to sub-optional level form and function to support a limited biotic community.
2. The unnamed tributaries to Flat Creek do not demonstrate the habitat potential for the development of a characteristic Gulf Coastal Seasonal biotic community. The limiting factors vary from study reach to study reach.
3. The flow (minimum even during the spring seasonal period) and stream morphology (no deep pools) of the small watersheds (UTC and UTB) limit the biotic community development.
4. The flows provided by the current discharge condition from EDCC provides a source of flow to allow increased community development when compared to upstream reference conditions.

4.3 Water Quality

4.3.1 Chemical Characteristics

This section presents the methods and results of the water quality characterization for *in-situ* and minerals analysis in all study reaches. The analytical methods followed procedures outlined in Standard Methods for the Examination of Water and Wastewater and appropriate EPA published methods as per the EDCC Aquatic Life Field Study Plan.

4.3.2 Methods

The water quality analysis was conducted during April 2005 to characterize instream conditions during spring seasonal period. Water quality analyses were taken within each study reach during the time of biological assessment. Water quality analyses consisted of *in-situ* measurements and grab samples for laboratory analysis of chloride, sulfate, and TDS. *In-situ* measurements for water temperature, dissolved oxygen (DO), and specific conductance were measured using a YSI Model 85 digital meter. The pH was measured using an Orion model 230A pH meter that was calibrated using the standard two point method. Turbidity was measured using a Hach 2100P turbidimeter. Grab samples were collected and preserved on ice for laboratory analysis of chloride, sulfate, and TDS. All field meters were calibrated the morning prior to use in the field. Calibration records, analytical results and chain of custodies are provided in Appendix E- Field Data Sheets.

4.3.3 Results and Discussion

The *in-situ* water quality data is presented in Table 4.4. DO ranged from 3.3 mg/L to 7.6 mg/L in the sampling reaches. The pH ranged between 6.43 and 7.36 s.u. along the three reaches evaluated. Specific conductivity was more than three times higher at downstream study reaches FC1 and FC2 (1919µS and 2249µS, respectively) when compared to all other reaches in the UTA watershed (maximum of 635µS). These increases reflect a result of residual effects from Flat Creek watershed and the oil and gas fields within that watershed.

In addition, the dissolved mineral concentrations of the upstream reaches, (UTC1 and UTA1), exceed the gulf coastal ecoregion standards.

Table 4.4. Summary of the water quality data from study reaches evaluated as part of the EDCC aquatic life field study Union County, AR. April 2005.

	Sampling Locations							
Measurement	UTC1	UTB1	UTB2	UTA1	UTA2	UTA3	FC1	FC2
Temperature, C°	22.03	23.20	22.93	23.40	23.57	24.93	24.27	23.57
Dissolved Oxygen, mg/L	4.19	7.59	7.23	3.30	5.84	6.21	6.11	5.31
Specific Conductance, uS	326.60	631.87	635.67	258.80	446.43	407.13	2249.33	1919.67
pH, su	7.09	7.36	7.29	6.60	7.08	7.12	6.43	6.91
Turbidity, ntu	46.07	12.37	14.03	27.00	23.73	21.83	11.17	7.25
Total Dissolved Solids mg/L	256.00	420.67	403.33	192.33	303.33	286.67	1250.00	1183.33
Chloride mg/L	13.13	223.70	32.70	58.37	30.20	25.63	616.00	549.67
Sulfate mg/L	31.77	65.70	67.20	3.87	35.87	32.73	44.57	32.03

Reported value is average of 3 measurements. Details of each individual measurement provided in Appendix D. Field data Sheets. Laboratory and in situ field data

4.3.4 Conclusions

1) The water quality of unnamed tributary to Flat Creek is sufficient to maintain the attainable fishery uses as long as habitat limitations (e.g. flow) do not prevent those uses.
2) The *in-situ* parameters measured during the study indicate that water quality supports the attainment of the designated aquatic life use and the development and maintenance of the biological integrity in stream reached evaluated.
3) Upstream (background) dissolved oxygen in the watershed of the unnamed tributary did not maintain the water quality standard for primary season Gulf Coast minimums.
4) The discharge from EDCC Outfall 001 provided the dissolved oxygen and flows to increase and maintain the seasonal minimums, enhancing the water quality of the unnamed tributary.
5) The background dissolved mineral concentrations exceeded the ecoregion based criteria for Cl, SO_4 and TDS.
6) Although the EDCC 001 outfall further elevated the dissolved mineral concentrations in UTA, the chloride and TDS concentrations were approximately 3 times greater in area reference streams (i.e. Flat Creek) than in the unnamed tributary into which EDCC discharges. This area reference reach was in Flat Creek upstream of the confluence with the unnamed tributary into which EDCC discharges.

4.4 Benthic Macroinvertebrate Community

4.4.1 Introduction

The benthic macroinvertebrate community reflects the effects of habitat availability, and the long term exposure to physical and chemical properties of the water in which it develops and lives. The presence and diversity of the benthic macroinvertebrate community reflects a water body's biological integrity.

4.4.2 Methods

An assessment of the benthic macroinvertebrate community was performed using rapid bioassessment (RBA) techniques as detailed in ADEQ, 1988. The methods were modified to sample in pool habitats. As indicated in Section 4.1, three sampling stations associated with the discharges were evaluated. UTB1 and UTB2 were on the unnamed tributary into which EDCC discharges and prior to any other major contribution. Reaches UTC1 and UTA1 are background reference condition within the same watershed and FC1 and FC2 were assessed as alternative reference conditions for larger watersheds (e.g., UTA2 and UTA 3) (Figure 2.1).

Macroinvertebrates were sampled using a Turtox Indestructible® dip net. Each station was sampled for three minutes according to the RBA protocol. The three minute sample period included time spent actively sampling the selected microhabitat and did not include time moving from microhabitat to microhabitat and/or sorting large debris particles from the sample to be processed.

Each sample was placed in a bucket and condensed using multiple washings into a standard #30 sieve. The samples were preserved in the field and transported to the lab for further processing, sub-sampling, identification and enumeration. In the lab, each of the field preserved samples were sub-sampled at random, placed on a grid, white sorting tray from which the macroinvertebrates sub-sample was collected. The white tray, with a 10 X 10 grid, was used to randomly select a 100 organism sub-sample from the qualifiedly collected benthic sample. Numbered grids were selected at random, from which all insects were collected and ultimately identified. Collections from individual grids continued until 100 organisms were collected. The 100 organism sub-samples were preserved in Kaylee's solution or 70% ethanol as a voucher for verification. The remainder of the original sample was concentrated, large particles removed, preserved in Kaylee's 'solution and retained as a voucher for the sample picking techniques used. These voucher samples will be held at GBM^c for a period of 24 months or until the project is completed. After project completion the samples may be contributed to a university zoological collection.

The macroinvertebrate assemblages from each station were analyzed according to several benthic community biometrics. These include richness (number of different taxa), EPT richness (number of different taxa represented in the orders Ephemeroptera, Plecoptera, and Trichoptera), and species diversity as determined by the Shannon-Wiener diversity Index. The field data sheets and biometric score forms are provided in Appendix E.

4.4.3 Results and Discussion

4.4.3.1 Overview

The species diversity was greatest (4.18) at the downstream most station on UTA (UTA3), and lowest (2.89) in the reference reach above the EDCC discharge (UTC1), indicating that the benthic community was improved, and more diverse (both taxonomically and functionally) downstream of the discharge of the EDCC facility than they were upstream in the reference reaches (UTA1, FC1, and FC2). This measure of invertebrate community development reflects the impact of the urban disturbances and the limited watershed size upstream of the facility (Reaches UTC1, UTA1 and FC1). The flow, augmented by the treated discharge from Outfall 001, maintains a constant wetted habitat in the downstream reaches. The benthic macroinvertebrate community assemblages of the study reaches are presented in Table 4.5.

The community metric assessment demonstrated some level of community development with in all reaches thus supporting the aquatic life use designation. The community metrics illustrated how similar the reaches were in development and complexity. Diptera was a dominant order in every reach and Crustacea was a dominant order in all but one study reach. The range in diversity indices was relatively small (2.89 to 4.84), and the top 5 dominant taxa comprised 63 to 77% of the benthic community, in 6 of 8 reaches.

The relationship to watershed size was reflected in the total number of taxa where the larger watersheds had the greatest number of taxa (Reaches UTA1, UTA2, and UTA3 **vs.** UTC1, UTB1, and FC1). This relationship of community development to watershed size was also demonstrated in the presence of EPT taxa, where EPT taxa were a subdominant order in all watersheds greater than 5 square. miles, but absent from smaller watersheds (Table 4.6).

There are unique functional assemblages where predators dominated the feeding assemblage. Typically, the collector functional group dominate gulf coastal streams with watersheds of 10 square mile or less, as demonstrated by Reaches UTC1 and UTA1. Predators dominated the reaches in UTB and FC. However, the effects of the elevated flows and the persistent velocity (two physical attributes) resulting from the Outfall 001 discharge, shift in the functional assemblage from collector to predator dominated communities is in response to these physical changes.

4.4.3.2 Reach UTC1

The upstream community (UTC1) demonstrated the minimum community diversity of all study reaches. The limited community was dominated by representatives from the order Crustacea and the sub-dominant order was the Diptera (true flies). These two orders comprised 75 percent of the benthic assemblage. The limited community development is directly related to the very small watershed size and limited persistent wetted habitat.

Table 4.5. Macroinvertebrate community assemblage collected from EDCC aquatic life field study reaches. Union Co. AR. April 2006.

Taxa/Station I.D.	Trophic Group	UTC1	UTB1	UTB2	UTB 2*	UTA1	UTA2	UTA3	FC1	FC2
ANNELIDA										
Oligochaeta	GC	5	2	--	--	2	2	2	--	--
Helobdella	PA	1	1	--	--	1	1	3	--	--
PELECYPODA										
Corbicula	FC	--	--	--	--	1	--	--	3	3
Physa	SC	--	--	--	--	1	--	--	2	--
CRUSTACEA										
Cambarinae	SH	3	--	3	--	--	9	8	3	1
Amphipoda	GC	32	7	5	21	17	14	4	9	4
Isopoda	GC	18	--	6	11	1	15	6	2	2
Palaemonetes	FC	--	--	--	--	1	--	3	--	--
EPHEMEROPTERA										
Caenis	GC	--	--	--	--	30	13	12	20	18
Callibaetis	GC	--	--	--	--	1	--	--	--	--
Stenacron	SC	--	--	--	--	1	--	--	--	--
ODONATA										
Argia	PR	--	2	6	--	8	5	6	21	18
Boyeria vinosa	PR	--	--	--	--	1	--	--	--	1
Calopteryx	PR	--	--	--	--	2	--	--	5	3
Enallagma	PR	--	9	3	1	5	2	--	14	6
Gomphus	PR	--	--	--	--	--	2	--	--	2
Hagenieus brevistylus	PR	--	--	--	--	--	--	1	--	1
Ophiogomphus	PR	--	--	--	--	--	1	--	2	9
Libellula	PR	--	--	--	--	1	--	--	--	--
Macromia	PR	--	--	--	--	--	--	2	--	2
Neurocordulia	PR	--	--	--	--	2	--	3	--	--
Perithemis	PR	--	--	--	--	1	--	--	--	--
HEMIPTERA										
Corixidae	PR	5	6	14	7	--	6	--	--	--
Ranatra	PR	--	--	--	--	--	1	--	--	--
MEGALOPTERA										
Sialis	PR	--	--	--	--	--	--	4	--	1
TRICHOPTERA										
Cheumatopsyche	PR	--	--	4	3	--	--	6	7	15
Polycentropus	PR	--	--	--	--	--	--	1	--	--

Table 4.5 (cont').

COLEOPTERA										
Ancyronyx	PR	--	3	5	--	--	2	2	--	--
Berosus		--	--	--	--	--	1	4	--	--
Dineutus (larvae)	PR	1	17	18	12	--	--	--	--	--
Dineutus (adult)	PR	--	3	6	1	--	1	--	--	--
Gyrinus	PR	--	6	--	--	--	--	--	--	--
Hydrovatus	SH	4	1	6	3	--	1	1	--	--
Peltodytes	SH	--	--	--	--	1	4	3	--	1
Stenelmis	PR	--	2	4	2		--	--	--	--
Scrites	PR	--	3	--	--	4	--	--	--	--
Tropisternus	PR	--	--	--	6	--	--	--	--	--
Uvarus	PR	3	--	4	8	--	--	--	--	--
DIPTERA										
Anopheles	FC	8	--	--	--	--	1	3	--	--
Bittacomorprpha	SH	1	--	--	--	--	--	--	--	--
Chaoborus	GC	7	27	17	14	--	--	--	--	--
Chironominae	FC	7	6	8	5	10	6	10	6	2
Hexatoma	PR	2	--	--	1	1	--	5	--	--
Orthocladiinae	PR	4	6	2	--	--	--	5	6	7
Probezzia	GC	--	--	--	--	11	2	--	1	4
Simulium	FC	--	3	3	6	--	--	3	--	--
Tanypodinae	PR	5	4	2	5	--	4	--	--	1
Sum of Percentages		100	100	100	100	100	100	100	100	100
Total Abundance		106	108	116	106	103	93	97	101	101
Species Richness		16	18	18	16	22	21	23	14	20
Shannon-Wiener Diversity Index		2.89	3.60	3.03	2.78	3.41	3.67	4.18	3.05	3.22

Table 4.6. Community metrics of macroinvertebrate assemblage collected during the EDCC aquatic life field study. Union Co. AR. April 2006.

Parameter / COMMUNITY MEASURES	UTC1	UTB1	UTB2	UTB2 Dupe	UTA1	UTA2	UTA3	FC1	FC2
Total number of Taxa (Richness)	16	18	18	16	22	20	23	14	18
EPT Richness	0	0	1	1	3	1	3	2	2
EPT % Abundance	0	0	3.4	3.1	32	14.6	19	27	33
Diversity Indices (Shannon-Wiener)	2.89	3.60	3.03	2.78	3.41	3.67	4.18	3.05	3.22
Total % of 5 Dominant Taxa	69	66	63	66	75	57	42	71	67
PERCENTAGE OF THE 4 DOMINANT ORDINAL GROUPS									
Ephemeroptera	--	--	--	--	31.1	14	11.9	19.4	17.8
Coleoptera	8	32	37	30.2	--	--	13.9	--	--
Diptera	25	43	28	29.2	21.4	12.9	22.8	12.6	13.9
Hemiptera	5	--	12	6.6	--	--	--	--	--
Odonata	--	10	8	--	19.4	10.8	11.9	40.8	41.6
Crustacea	50	6.5	--	30.2	18.4	40.9	20.8	13.6	6.9
RANK OF THE 4 DOMINANT ORDINAL GROUPS									
Ephemeroptera	--	--	--	--	1	2	4	2	2
Coleoptera	3	2	1	1.5	--	--	3	--	--
Diptera	2	1	2	3	2	3	1	4	3
Hemiptera	4	--	3	4	--	--	--	--	--
Odonata	--	3	4	--	3	4		1	1
Crustacea	1	4	--	1.5	4	1	2	3	4
FUNCTIONAL FEEDING ASSEMBLAGES %									
Shredders	7.5	0.9	7.8	2.8	1.0	15.1	11.9	2.9	2.0
Scrapers	0.0	0.0	0.0	0.0	1.9	0.0	0.0	1.9	0.0
Filterers	14.0	8.3	9.5	10.4	11.7	11.8	23.8	14.6	12.9
Collectors	59.0	33.3	24.1	43.4	60.2	49.5	23.8	31.1	27.7
Predators	19.0	56.5	58.6	43.4	24.3	21.5	33.7	49.5	57.4
RANK OF FUNCTIONAL FEEDING ASSEMBLAGES									
Shredders	4	4	4	4	--	3	4	4	4
Scrapers	--	--	--	--	4	--	--	--	--
Filterers	3	3	3	3	3	4	2.5	3	3
Collectors	1	2	2	1.5	1	1	2.5	2	2
Predators	2	1	1	1.5	2	2	1	1	1
Biometric Score*:									

4.4.3.3 Reach UTB1

The aquatic life use is maintained in UTB1 during the seasonal period. The invertebrate community of Reach UTB1 demonstrated the 3rd highest diversity, despite having the 2nd smallest watershed. This benthic assemblage was directly supported by the flows from EDCC Outfall 001. There was no single dominant order. The co-dominants were Diptera (true flies) and Coleopteran (beetles). The feeding assemblage was atypical of expected gulf coastal assemblages in that predators dominated the benthic assemblage. This shift was also in response to the discharge from EDCC Outfall 001. The increased flows and associated hydraulics artificially increased the "functional" watershed size.

4.4.3.4 Reach UTB2

The aquatic life use is maintained in UTB during the seasonal period. As expected the benthic community in Reach UTB2 was very similar to that of UTB1. Although the diversity was reduced slightly, both had 18 taxa. Also, the co-dominate orders and the functional feeding assemblage were almost identical to that of UTB1. There were no taxa in the UTB2 assemblage that were not collected in other reaches.

4.4.3.5 Reach UTA1

As would be expected, the aquatic life use is maintained in Reach UTA1 during the seasonal period. The benthic community in Reach UTA1 represents the background condition. Although the flows were limited due to beaver activity, the increased watershed size of UTA1 is reflected in the diversity and increase in taxonomic richness, when compared to the smaller watershed reaches (UTB and UTC). The diversity was 3.41, with 2nd greatest taxonomic richness of all reaches evaluated.

The ordinal composition reflected the increased watershed and the habitat development of the reach. There were no dominant orders and 4 orders were collected in relatively the same percentage. These included mayflies, odonates (dragonflies and damselflies), diptera and crustacean. Mayflies and odonates were not present in significant numbers in any of the smaller study reaches.

The functional feeding assemblage also reflected the expected typical gulf coastal benthic composition where gathering collectors comprised approximately 2/3 of the group followed by predators and filtering collectors. There were no significant taxa in the UTA1 assemblage that were not collected in other reaches.

4.4.3.6 Reach UTA2

The aquatic life use is being maintained in Reach UTA2 during the seasonal period. Reach UTA2 is downstream of the mouth of UTB and includes flows from EDCC Outfall 001. The diversity was higher than that of the upstream reference despite having 2 less taxa. This increased diversity is reflected in the numerical abundance of the 5 dominant taxa identified from the benthic sample. At UTA2, the 5 dominant taxa comprised only 57% of the sub-sample, second smallest of the reaches evaluated. Typically, in small gulf coastal streams, the dominant 5 taxa will comprise 65 to 70 percent of the assemblage. The smaller the "dominants percentage", the more balanced the distribution of benthic organisms.

The ordinal composition varied for the upstream reference and was dominated by Crustacea, reflecting a large crayfish population in the reach. The sub-dominate orders were the same as the upstream reference UTA1.

Although more evenly distributed amongst the various groups, the functional feeding assemblage also reflected the expected typical gulf coastal benthic composition where gathering collectors comprised the majority, followed by predators and then filtering collectors. There were no taxa in the UTA2 assemblage that were not collected in other reaches.

4.4.3.7 Reach UTA3

The aquatic life use is being maintained in Reach UTA3 during the seasonal period. Reach UTA3 is downstream of UTA2 and also includes flows from EDCC Outfall 001. The benthic community was found to be the most diverse at this study reach with 23 taxa identified. This increased diversity is also reflected in the numerical abundance of the 5 dominant taxa identified from the benthic sample. This metric at UTA3 was only 42% of the sub-sample, the lowest of the reaches evaluated. Typically the metric range from the mid 60's to low 70's. This indicates a balanced distribution of benthic organisms where no individual group of taxa dominates the assemblage.

The balance and diversity of the benthic community was further demonstrated in that there was no dominant ordinal group and that there were 5 co-dominant orders, only one of which exceeded 20% of the assemblage.

The functional feeding assemblage also reflected the high degree of diversity with the distribution more evenly distributed. There were no taxa in the UTA3 assemblage that were not collected in other reaches.

4.4.3.8 Reach FC1

The aquatic life use is being maintained in Reach FC1 during the seasonal period, despite the non-point and point source influences within the watershed. Reach FC1 is a reference reach and reflects a watershed similar to UTA1. This Reach had the lowest taxonomic richness of any reach evaluated, including the smallest watersheds (UTC1 and UTB1). Other than the reduced taxonomic richness, the benthic community reflected the characteristics (e.g. ordinal dominance and functional feeding assemblages) of the other reaches in the UTA watershed. There were no taxa in the FC1 assemblage that were not collected in other reaches.

4.4.3.9 Reach FC2

The aquatic life use is being maintained in Reach FC2 during the seasonal period, despite the non-point and point source influences within the watershed as illustrated in the water quality parameters measures (See Section 4.3.3). Reach FC2 is a reference reach and was evaluated to compare to Reach UTA3. The benthic community development of UTA3 demonstrated a more balanced and diverse assemblage that what was indicated in FC2, in most all measures endpoints (diversity, taxa richness, taxa dominance, ordinal composition and functional assemblage.

This comparison demonstrates that the discharge from EDCC Outfall 001 supports, and likely enhances, the benthic community development in UTA and maintains the aquatic life use despite the increased mineral concentrations that are present in the discharge. The dissolved

minerals are less in the Outfall 001 receiving stream (UTA) than in the adjacent watersheds (FC) that receive storm and other non-point source flows flow from developed oil and gas production areas.

4.4.4 Conclusions

Based on the analysis of the macroinvertebrate collection completed as part of the aquatic life field study to develop the required documentation, the following conclusions are provided:

1) The macroinvertebrate community is being fully maintained downstream of the EDCC 001 effluent discharge, as is the designated aquatic life use.
2) The aquatic life designated use is being maintained during the seasonal period in all reaches evaluated.
3) The macroinvertebrate communities observed at all study reaches are similar in the development of taxonomic diversity during the seasonal period.
4) Biometric comparisons indicate that there are minimal differences in the benthic communities.
5) The community structure (form and function) demonstrated minimal differences which could be attributed to differences in physical conditions of the individual stream reach evaluated.
6) The macroinvertebrate communities observed at the unnamed tributary (UTA) to Flat Creek reaches are similar in structure and composition to Gulf Coastal Plain ecoregion conditions for small watersheds. However, the complexity of the community was limited when compared to least disturbed streams, even in the reference site (UTA1).
7) Comparisons of the benthic community development from the UTA study reaches to those from the Flat Creek study reaches, indicate that the UTA benthic communities are more diverse and characteristic of typical gulf Coastal assemblages than those in the Flat Creek watershed.
8) The biological integrity of Unnamed tributary to Flat Creek is being supported by the existing discharge conditions, however, the biological integrity of UTB and to a lesser degree UTA downstream of the discharge, would be negatively impacted should the discharge from Outfall 001 be eliminated.

4.5 Fish Community

4.5.1 Introduction

The fish community supported in a stream is in direct response to available habitat, food sources, and water quality of that particular stream. The presence of a certain level of species richness and diversity along with a community structure similar to that expected in typical streams of a ecoregion are indicators of aquatic ecosystem health.

The objective of the fish community characterization is to collect and identify a representative sample of all except very rare species in the assemblage reflective of the relative abundance within the community. Backpack electrofishing equipment is used as the principal sampling gear supplemented by block netting and seining in habitats where flow, substrate and structure affect the capture of fish species. Other methods of fish sampling may be implemented when conditions are not adequate for backpack eletrofishing or seining; these may include, using boat electrofishing equipment and/or hook and line sampling equipment. Usually 2 – 4 team members will make up the sampling team involved in collecting the aquatic vertebrates.

Major factors that influence collecting include flows, water depth, instream obstructions, water turbidity, temperature and conductivity. The primary tool utilized in the fish collections was a Smith-Root backpack electroshocker. However, seines and block nets were utilized as necessary to adequately characterize a sampling reach. The shocker is equipped with an automated timing mechanism which records the amount of time that electricity is actually being applied, or "pedal down time" (PDT).

Sampling fish species to determine their proportionate abundance will be conducted after all water quality parameters and/or samples are collected but prior to the collection of the macroinvertebrate sample and habitat data.

Shocked fish were captured with hand held dip nets and held in buckets while the sampling continued. The entire stream width within the sampling reach will be sampled. PDT time will continue for not less than 30 minutes unless the wetted habitat of any reach limits the PDT. In addition to the PDT, the total collection time will be recorded.

Unless specified in a project specific sampling analysis plan (SAP), there will not be a maximum time limit for the collection period; however the collections may be terminated when, in the opinion of the principal investigator, it is determined that a representative collection has been obtained. Sampling information is recorded on the Fish Community Collection Form, general comments (perceived fishing efficiency, missed fish, and gear operation suggestions) will be recorded on the lines provided on this form.

An effort to search for and collect fish will be completed at all reaches, even if the stream is extremely small, and it appears that sampling may not collect any specimens. If no specimens are collected, the "NONE COLLECTED" field on the Fish Collection Form will be completed and will provide an explanation in the comments section of the form.

4.5.2 Methods

An assessment of the fish community in unnamed tributaries to Flat Creek (UTC1, UTB1, UTB2, UTA1, UTA2, and UTA3) and 2 sites on Flat Creek was completed as per the aquatic life field study plan during the spring of 2006. Each reach was sampled using a Smith-Root backpack electroshocker. The shocker includes an automated timing mechanism which records the amount of time that electricity is actually being applied, or "pedal down time" (PDT).

Shocked fish were captured with hand held dip nets and held in buckets while the sampling continued. At the end of each sampling effort fish from both reaches were preserved in formalin for later identification in the lab. Fish identifications were made according to the Fishes of Arkansas (Robison, 1988) and The Fishes of Missouri (Pflieger, 1975) to species level where possible.

The fish collections at each reach were compared according to several biometrics including: species richness (number of taxa); sunfish richness; species diversity; abundance; dominant family groups; percent of tolerant species; trophic structure; percent of hybrids; percent of diseased fish; and key and indicator species as listed in Reg. No. 2. In addition, the fish community was assessed using a Biocriteria method developed by ADEQ. This Biocriteria uses a scoring system by which the assemblage collected is compared to a reference stream in the same ecoregion using eight different metrics. The metric scores are totaled and the resulting sum is used to assess if a stream reach is in support of its assigned designated uses.

4.5.3 Results and Discussion

All study reaches were found to support a seasonal fish community demonstrating that the discharge from EDCC Outfall 001 does not preclude the seasonal use attainment. Table 4.7 provides a summary and assessment of the fish communities as identified from each study reach. The total number of species collected from any individual study reach varied from a low of 9 (FC1) to 20 (UTA2) and the catch per unit effort ranged from 1.40 (FC1) to 6.03 (UTC). Table 4.8 provides a summary of the individual fish species collected from each study reach and a summary of the community assemblage.

The community assessment indicates that UTA2 supports the most diverse community assemblage.

4.5.3.1 Reach Comparisons

The fish community assemblage indicates subtle differences in the fish community structure within each study reach. This variability is largely driven by the site flow mechanics and the resulting long term effect on habitat and the benthic community development.

Reach UTC1

A total of 11 species were collected from Reach UTC1. The sample effort resulted in the highest catch per unit effort with 6.03 fish collected per minute of PDT. This indicated that the habitat was sufficient to support the fish community during the seasonal period. However, the stream reach evaluated was limited (short) and the level of effort was lowest of any reach (10.1 minutes) due to lack of sustained wetted stream habitat. The only species collected from UTC1 that was not common to the watershed was the pirate perch. The only other reach the

pirate perch was collected was the upstream reference (UTA1). The fish assemblage for UTC1 included five Gulf Coastal ecoregion key and indicator species.

A biocriteria scoring system, as developed by ADEQ, was used to evaluate the fish community as it is compared to "least disturbed Gulf Coastal streams". The biocriteria assessment resulted in a total of 12 points out of 32 possible points at UTC1. This is considered low and falls in the biocriteria category of "Impaired" when compared to an ecoregion least disturbed reference site. The low score at UTC1 is directly affected by a small watershed (1.15 mi^2), which causes UTC1 dry up during certain times of the year. Additional factors that contributed to the low scores were; the absence of sensitive species, catfishes, and darters, as well as an over abundance of sunfish representatives and low species diversity within the study reach. Biocriteria scoring sheets are provided in Appendix E.

Table 4.7. Fish community structural analysis of reaches evaluated during the aquatic life field study for EDCC, Union County, AR, April 2005.

PARAMETER	STUDY REACHES							
COMMUNITY MEASURES	UTC	UTB1	UTB2	UTA1	UTA2	UTA3	FC1	FC2
Richness (Total Number of Taxa)	11	12	11	12	20	13	11	9
Darter Richness (Number of Taxa)	0	2	0	1	2	1	0	0
Sunfish Richness (Number of Taxa)	3	4	3	6	7	4	6	4
% Pollution Tolerant Species	3.3	5.9	13.1	0	4.9	11	18.9	8.2
% Pollution Intermediate Species	96.7	94	82.8	100	94.1	87	81.1	91.8
% Pollution Intolerant Species	0.0	0	4	0	1	2	0	0
Number of Key & Indicator Species (Taxa)	5	5	4	5	7	6	4	5
Number of Key & Indicator Species (Individuals)	19	19	45	30	56	30.0	9	29
% Key & Indicator Species numbers of total fish	31.1	55.9	45.5	34	18.4	30.0	12.2	47.5
Diversity Indices (Shannon-Wiever)	2.84	2.86	2.91	3.35	2.67	2.99	2.42	2.67
Abundance, fish collected/minute	6.03	2.8	3.44	3.33	5.26	2.31	1.76	1.4
TROPHIC STRUCTURE								
% Herbivores	0	0	0	0	0	0	0	0
% Omnivores	3.28	5.9	13.1	0	4.6	6	10.81	0
% Insectivores	93.4	91	80.8	87.6	91.8	92.0	86.5	96.7
% Piscivores	3.28	2.9	6.1	12.4	3.6	2.0	2.7	3.3
PERCENT OF 5 DOMINANT FAMILY GROUPS								
Cyprinidae	21.3	47.1	44.4	5.6	15.1	19	10.8	16.4
Poeciliidae	23	0	3	15.7	13.1	10	20.3	0
Cyprinodontidae	8.2	8.8	0	4.5	1.3	1	0	0
Esocidae	1.6	2.9	5.1	1.1	0.7	1.0	0	3.3
Aphredoderidae	8.2	0	0	4.5	0	0	0	0
Ictaluridae	0	0	1	0	0.3	5	1.4	8.2
Centrarchidae	36.1	29.4	34.3	59.6	65.9	55	59.5	60.7
Catostomidae	1.6	2.9	12.1	0	0.3	4.0	2.7	4.9
Percidae	0	8.8	0	4.5	1.3	1	0	0
Total % of 5 Dominant Groups	96.7	100	99	98.9	98.7	94	98.6	96.7

* Total of 12 key and indicator species possible.

Table 4.8. Fish community assemblages of reaches evaluated during the aquatic life field study for EDCC, Union County, AR, April 2006.

	STUDY REACH	UTC1	UTB1	UTB2	UTA1	UTA2	UTA3	FC1	FC2
Scientific Name	**Common Name**	4/20	4/20	4/20	4/18	4/18	4/17	4/17	4/17
CYPRINIDAE									
Lythrurus umbratilis[1]	redfin shiner	11	14	27	5	29	11	--	10
Cyprinella venusta	blacktail shiner	--	--	--	--	1	6	--	--
Notemigonus crysoleucas	golden shiner	--	--	9	--	10	--	--	--
Opsopoeodus emiliae	pugnose minnow	--	--	4	--	3	2	--	--
Semotils atromaculatus	creek chub	2	2	4	--	3	--	8	--
CATOSTOMIDAE									
Erimyzon oblongus[2]	creek chubsucker	1	1	12	--	1	4	2	3
POECILIIDAE									
Gambusia affinis	mosquitofish	14	--	3	14	40	10	15	--
CYPRINODONTIDAE									
Fundulus olivaceus	blackspotted topminnow	4	2	--	8	9	5	1	5
Fundulus crysotus	golden topminnow	1	1	--	--	1	--	--	--
ESOCIDAE									
Esox americanus[1]	grass pickerel	1	1	5	1	2	1	--	2
APHREDODERIDAE									
Aphredoderus sayanus[2]	pirate perch	5	--	--	4	--	--	--	--
ICTALURIDAE									
Ameiurus natalis[1]	yellow bullhead	--	--	--	--	1	5	4	4
Ameiurus melas	black bullhead	--	--	1	--	--	--	--	--
CENTRARCHIDAE									
Lepomis X Hybird	Sunfish	--	--	--	--	--	--	2	1
Lepomis cyanellus	green sunfish	5	3	11	7	25	9	2	4
Lepomis gulosus[1]	warmouth	1	--	1	7	8	1	2	--
Lepomis punctatus[2]	spotted sunfish	--	1	--	13	13	8	1	10
Lepomis macrochirus	bluegill sunfish	--	1	--	11	3	--	2	--
Lepomis megalotis	longear sunfish	16	5	22	12	149	37	35	22
Centrarchus macropterus[2]	flier	--	--	--	--	2	--	--	--
Micropterus salmoides	largemouth bass	--	--	--	3	1	--	--	--
PERCIDAE									
Etheostoma gracile[1]	slough darter	--	2	--	--	--	--	--	--
Etheostoma proeliare	cypress darter	--	--	--	--	3	--	--	--
Etheostoma chlorosomum	bluntnose darter	--	1	--	4	1	1	--	--
Total No. Taxa Collected		11	12	11	12	20	13	11	9
Total Fish Collected		61	34	99	89	305	100	74	61
Level of Effort (Minutes) PDT[3]		10.1	12.2	28.8	26.8	58.0	43.3	42.1	43.7
Catch per Minute, PDT		6.03	2.80	3.44	3.33	5.26	2.31	1.76	1.40
Shannon-Wiever Diversity Index		2.84	2.86	2.91	3.35	2.67	2.99	2.42	2.67

[1] Typical Gulf Coastal Ecoregion Key Species
[2] Typical Gulf Coastal Ecoregion Indicator Species
[3] Pedal Down Time

Reach UTB1

A total of 12 species were collected from Reach UTB1. This indicated that although the habitat was the least developed of any reach evaluated, it existing habitat was sufficient to support the fish community during the seasonal period. However, the population density was low and the numerical abundance was the lowest of any reach evaluated. The community was overwhelmingly dominated be insectivores with cyprinids comprising almost 50 percent of the community. The fish assemblage for UTB1 included five Gulf Coastal ecoregion key and indicator species which comprised 56 percent of the specimens collected, and included 2 darter species

The biocriteria assessment resulted in a total of 14 points at UTB1. The 14 total points, out of a possible 32, placed UTB1 in the "Impaired" category when compared to an ecoregion least disturbed reference site. However, UTB1 which is the EDCC Outfall 001 discharge ditch, fell into the same biocriteria category as all of the reference sites evaluated during this study (UTC1, UTA1, FC1, & FC2). The low scores for UTB1 reflect the small watershed size (1.17 mi^2), absence of sensitive species and catfishes, an over abundance of green sunfish in the total sunfish population of UTB1, and low species diversity within the study reach.

Reach UTB2

A total of 11 species were collected from Reach UTB2. The sample effort resulted in the 3rd highest catch per unit effort and the 2nd highest diversity indices. This indicated that the habitat was sufficient to support the fish community during the seasonal period. The fish assemblage for UTB2 included four gulf coastal ecoregion key and indicator species.

The biocriteria assessment resulted in a total of 16 points at UTB2. The 16 total points, out of a possible 32, placed UTB2 in the "Impaired" category when compared to an ecoregion least disturbed reference site. However, and more importantly, UTB2 fell into the same biocriteria category as any of the reference sites completed during this study (UTC1, UTA1, FC1, & FC2). The low scores for UTB2 reflect the small watershed size (2.37 mi^2), absence of catfishes, darters, as well as an over abundance of green sunfish within the total sunfish population and low species diversity within the study reach.

Reach UTA1

A total of 12 species were collected from Reach UTA1. The sample effort resulted in the highest species diversity from any reach evaluated. The fish community was dominated by sunfish species. This fish assemblage indicated that the habitat was sufficient to support the fish community during the seasonal period. The only species collected from UTA1 that was not common to the watershed was the largemouth bass and the pirate perch. The fish assemblage for UTA1 included five Gulf Coastal Ecoregion key and indicator species.

The biocriteria assessment resulted in a total of 10 points at UTA1. This reach represents the upstream reference condition prior to any impact of the EDCC 001 discharge. The 6.0 mi^2 watershed also had a significant affect on the biocriteria score. The 10 total points, out of a possible 32, placed UTA1 in the "Impaired" category when compared to an ecoregion least disturbed reference site. This reach scored lower than any of the other reaches previously described. The low score at UTA1 reflects the small watershed size, absence of sensitive species, catfishes, darters, as well as an over abundance of sunfish species and low species diversity within the study reach.

Reach UTA2

A total of 20 species were collected from Reach UTA2, almost doubling that of any other reach evaluated. The level of effort resulted in the 2nd highest catch per unit effort (5.26 fish per minute of PDT) and the highest number of fish collected (more than 3 times that of any other study reach). The habitat was conducive to fish collections with wide shallow channel flow and developing habitat in a variety of habitat types. The habitat was sufficient to support a gulf coastal fish community during the seasonal period, and probably during the low flow critical season. The only species collected from UTA2 that was not common to the watershed were the largemouth bass and the cypress darter. The fish assemblage for UTA2 included eight (8) Gulf Costal Ecoregion key and indicator species, more than any other study reach.

The biocriteria assessment resulted in a total of 12 points at UTA2. The 12 total points, out of a possible 32, placed UTA2 in the "Impaired" category when compared to an ecoregion least disturbed reference site. However, and more importantly, UTA2 fell into the same biocriteria category as any of the reference sites completed during this study (UTC1, UTA1, FC1, & FC2). The low scores for UTA2 reflects the biocriteria development focus on "least disturbed" streams with watersheds that are significantly larger that those targeted within this watershed.

Reach UTA3

A total of 13 species were collected from Reach UTA3. The sample effort resulted in the 2nd highest diversity measure (2.99). This indicated that the habitat was sufficient to support the fish community during the seasonal period. However, the catch per unit effort was the lowest within the UTA watershed. The fish assemblage sampled from Reach UTA3 included six (6) Gulf Costal Ecoregion key and indicator species.

The biocriteria assessment resulted in a total of 18 points at UTB1, the highest of all stations studied during this project. The 18 total points, out of a possible 32, placed UTA3 in the "Generally Supporting" category and when compared to an ecoregion least disturbed reference site. However, UTA3 scored higher then any reference site evaluated during this study (UTC1, UTA1, FC1, & FC2).

Reach FC1

A total of 11 species were collected from Reach FC1. The sample effort resulted in the 2nd lowest catch per unit effort with 1.76 fish collected per minute of PDT. This indicated that the fish community of Flat Creek, while being maintained at a reduced level, was not characteristic of the surrounding watershed level of sustainability and that some factor was limiting the community development. FC1 is not impacted by the discharge from the EDCC facility and therefore does not receive any benefit from the sustained flows during the dry summer periods. Although sufficient to support the fish community during the seasonal period, the limited flow and the contributions from the watershed, limit the fish community development when compared to the fish community of UTA. The fish assemblage at FC1 included four Gulf Costal Ecoregion key and indicator species.

The biocriteria assessment resulted in a total of 12 points at FC1. The 12 total points, out of a possible 32, placed FC1 in the "Impaired" category when compared to an ecoregion least disturbed reference site.

Reach FC2

Only nine (9) species were collected from Reach FC2, lowest of any reach evaluated. The limited fish community development probably reflects the effect of non-point contributions from the developed oil and gas production field through which Flat Creek flows. The water quality measurements recorded during the aquatic life field study indicated conductivity and TDS values that were more than 3 times higher than that measured in the UTA watershed, even with the discharge from EDCC Outfall 001 (See Section 4.3.3). The fish assemblage for FC2 included five (5) Gulf Costal Ecoregion key and indicator species.

The biocriteria assessment resulted in a total of 16 points at FC2. The 16 total points, out of a possible 32, placed FC2 in the "Impaired" category when compared to an ecoregion least disturbed reference site. The low score at FC2 reflects the , absence of sensitive species, darters, as well as an over abundance of sunfish species and low species diversity within the study reach.

4.5.4 Conclusions

Based on the results of the fish collections, the following conclusions are provided:

1) The fish assemblages collected at all study reaches, upstream reference reaches and downstream of the EDCC Outfall 001, are similar in structure and function indicating that the biological integrity required to maintain the seasonal fishery is being supported.
2) The communities at all reaches, except the smallest watersheds, were found to be dominated by sunfish during the seasonal period.
3) The communities were similar to those expected in a gulf coastal plain streams of similar watershed size, therefore, the fishery downstream from the discharges is being maintained, as is the designated aquatic life use.
4) The numbers of fish and diversity collected downstream during the seasonal study exceeds and/or equals those collected in reference reaches.
5) All fish assemblages were found to contain at least 4 of the key and indicator species as listed by the water quality standards (Regulation No.2).
6) Applying the ADEQ fish community biocriteria to these study reaches resulted in all but one study reach scoring in the "impaired" category although each maintained a fish community that were characterized by multiple key and indicator species for the ecoregion. This approach exposes the limitations of categorizing communities in very small watersheds that receive some type of point-source discharge watersheds based on comparisons to fish communities in larger and least disturbed watershed. Although the fish community "scored" impaired, the communities frequently comprised a majority of the identified ecoregion sensitive and or Key species.

4.6 Summary

Based on the aquatic life field study, the designated aquatic life use (seasonal fishery) and the biological integrity of unnamed tributary to Flat Creek is maintained downstream of the existing water discharges from the EDCC facility. In fact, the augmentation of flow from the discharge serve to enhance the potential for community development as illustrated by the comparisons between the upstream reference condition and the downstream study reaches.

5.0 EXISTING LOADINGS OF DISSOLVED MINERALS

5.1 Chloride, Sulfate, and TDS Water Quality Criteria

Currently, the unnamed tributary to the unnamed tributary of Flat Creek (UTB), the unnamed tributary of Flat Creek (UTA), Flat Creek, and Haynes Creek's minerals water quality criteria are ecoregion based numbers. The existing ecoregion based chloride, sulfate and TDS water quality criteria for UTB, UTA, Flat Creek, and Haynes Creek is 14 mg/L, 31 mg/L, and 123 mg/L, respectively. Utilizing the applicable flows, background concentrations provided in the WQS and the applying the methods stipulated in the Continuous Planning Process (CPP), Outfall 001's discharge from the EDCC facility will not maintain the existing ecoregion based dissolved minerals criteria in UTB, UTA, Flat Creek, or Haynes Creek.

In addition to ecoregion based water quality criteria, the domestic water supply use designation for UTB, UTA, Flat Creek, or Haynes Creek results in a numeric criterion of 250 mg/L, 250 mg/L and 500 mg/L for chloride, sulfate and TDS, respectively. As discussed in Sections 3.2 and 3.3, the domestic water supply use is a designated, but not an existing use for UTB, UTA, Flat Creek, or Haynes Creek. Additionally, there are no plans to utilize any of these streams as a domestic water supply use.

In order to determine appropriate chloride, sulfate, and TDS criteria for UTB, UTA, Flat Creek, and Haynes Creek, mass balances were developed as described in the following sections.

5.2 Mass Balance

The following mass balance equation was used to calculate instream waste concentrations (IWC) for chloride, sulfate, and TDS:

$$IWC = [(Qb \times Cb) + (Qe \times Ce)] / (Qb + Qe)$$

Where:

Qb = The background flow of the receiving stream
Cb = The background concentration of chloride, sulfate, or TDS in the receiving stream
Qe = The discharge flow of the effluent
Ce = The effluent concentration of chloride, sulfate, or TDS

5.2.1 Methods

The procedure for evaluating instream concentrations and developing permit limits for dissolved minerals can be found in *ADEQ Discharge Permit, Toxic Control Implementation Procedure* in Arkansas' 1995 Continuing Planning Process (CPP). The value used for the background concentration in the UTB tributary, of chloride (5 mg/L), sulfate (13 mg/L), and TDS (67 mg/L), was the mean concentration for the Gulf Coastal Plain Ecoregion. The background values are listed in the CPP in Attachment XII, *Mineral Permitting Strategy*, for streams in the Gulf Coastal Plain with a 7Q-10 of less than 100 cfs. A background flow of 4 cfs was used in each stream, as allowed for determining instream mineral concentrations in the WQS. Outfall

001 effluent concentrations for chloride and TDS were derived from facility DMR data collected from June, 2004 through April, 2006. An effluent concentration for sulfate was derived from DMR data collected from January, 2002 through April, 2006 from Outfall 001. Instream concentrations were calculated for Unnamed tributary to unnamed tributary of Flat Creek (UTB), Unnamed tributary of Flat Creek (UTA), Flat Creek, and Haynes Creek.

5.2.2 Computations for UTB tributary (from Outfall 001 to Unnamed tributary of Flat Creek (UTA))

The Gulf Coastal Plain ecoregion background concentrations for chloride, sulfate, and TDS are 5 mg/L, 13 mg/L, and 67 mg/L, respectively. EDCC's reported highest monthly average flow for Outfall 001 from July 2002 through April 2006 is 1.499 mgd (2.319 cfs). The flow value used in the computations as the effluent flow at Outfall 001 selected as directed by Section D of *ADEQ Discharge Permit, Toxic Control Implementation Procedure* in the CPP. A concentration of 55.0 mg/L chloride, 309 mg/L sulfate, and 1170 mg/L TDS were used as the effluent concentrations. Each of these values is the 95th percentile of its respective data set. The method used to calculate the 95th percentile was a parametric (the data set was normally distributed) statistical technique, as outlined in *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987). A frequency histogram was prepared for each data set to characterize the distribution. Computations for pertinent minerals at Outfall 001 are presented below. A schematic depiction of the 95th percentile contributions of the respective mineral and flows used from each source utilized in the development of predicted instream waste concentration and the proposed water quality standard modification for each stream segment is provided in Appendix C. Additionally, frequency histograms of each data set were prepared so a visual check of its normality distribution could be made. The chloride, sulfate, and TDS data visually appeared to have a normal distribution. Therefore, the 95th percentile for the chloride, sulfate, and TDS data was calculated using a nonparametric technique (Gilbert, 1987) presented below:

$X_P = \bar{x} + (Z_p * s)$

where:
- X_P = desired percentile
- $\bar{x}$ = sample mean of the mineral data set
- Z_p = statistical "look up value" for the standard normal distribution of the desired percentile
- s = standard deviation of the mineral data set

This method returns Z_p values of 1.64 for the 95th percentile, a standard deviation of 9, 68, & 179 for chloride, sulfate, and TDS data sets, respectively. The sample mean values for chloride, sulfate, and TDS data sets were 41, 197, and 875, respectively. This data returned 95th percentile values of 55, 309, and 1170 for chloride, sulfate, and TDS, respectively. Flow values used in the following calculations (1.499 mgd or 2.319 cfs) is the reported highest monthly average flow for a period from July 2002 through April 2006 at Outfall 001. Utilizing all the aforementioned data the IWC is calculated below. The summary of the mass balance data inputs are provided in Table 5.1 for UTB.

$IWC_{chloride}$ =
[(4.0 cfs x 5.0 mg/L) + (2.139 cfs x 55 mg/L)] / (4.0 cfs + 2.139 cfs)=23 mg/L,

$IWC_{sulfate}$ =
[(4.0 cfs x 13 mg/L) + (2.139 cfs x 309 mg/L)] / (4.0 cfs + 2.139 cfs) = 122 mg/L, say 125mg/L

IWC_{TDS} =
[(4.0 cfs x 67 mg/L) + (2.139 cfs x 1170 mg/L)] / (4.0 cfs + 2.139 cfs) = 472 mg/L, say 475mg/L

Table 5.1. Instream Waste Concentration (IWC) Calculation for UTB.

Parameters	Chloride	Sulfate	TDS
Ce, mg/L (projected 95th %tile)	55	309	1170
Cb, mg/L	5.0	13.0	67.0
Qe, cfs	2.139	2.139	2.139
Qb, cfs	4.0	4.0	4.0
Projected IWC (mg/L)	23	122	472

Appendix C. provides a schematic of the 95th percentiles, flows, and IWC computations for the individual dissolved minerals.

5.2.3 Computations for UTA tributary (from confluence with UTB to Flat Creek)

The IWC computations for chloride, sulfate, and TDS for UTA tributary (from confluence with UTB to Flat Creek) were preformed utilizing the previously calculated IWCs and flows from UTB tributary (Section 5.2.2 above) as the "effluent concentration" and "effluent flows" for each respective mineral. The "effluent concentration" for chloride, sulfate, and TDS at UTA were 23, 122, & 472, respectively. "Effluent flow" values are the combined flows form UTB background flow (4 cfs) and Outfall 001's reported highest monthly average flow for a period from July 2002 through April 2006. The resulting "effluent flow" value used in the IWC computations was 6.319 cfs. The calculated IWC for chloride, sulfate, and TDS indicated higher concentrations than the current ecoregion based water quality criteria for UTA. Utilizing all the aforementioned data the following calculations were used to determine the IWC for each relevant mineral at UTA and summarized in Table 5.2.

$IWC_{chloride}$ =
[(4.0 cfs x 5 mg/L) + (6.319 cfs x 23 mg/L)] / (4.0 cfs + 6.139 cfs) = 16 mg/L

$IWC_{sulfate}$ =
[(4.0 cfs x 13.0 mg/L) + (6.319 cfs x 122 mg/L)] / (4.0 cfs + 6.139 cfs) = 80 mg/L

IWC_{TDS} =
[(4.0 cfs x 67 mg/L) + (6.319 cfs x 472 mg/L)] / (4.0 cfs + 6.139 cfs) = 315 mg/L

Table 5.2. Instream Waste Concentration (IWC) Calculation for UTA.

Parameters	Chloride	Sulfate	TDS
Ce, mg/L	23	122	472
Cb, mg/L	5.0	13.0	67.0
Qe, cfs	6.319	6.319	6.319
Qb, cfs	4.0	4.0	4.0
Projected IWC (mg/L)	16	80	315

5.2.4 Computations for Flat Creek (from confluence with UTA to Salt Creek)

The IWC computations for chloride, sulfate, and TDS for Flat Creek (from confluence with UTA to Salt Creek) were preformed utilizing the previously calculated IWCs and flows from UTA tributary (Section 5.2.3 above) as the "effluent concentration" and "effluent flows" for each respective mineral. The "effluent concentration" for chloride, sulfate, and TDS in Flat Creek were 16, 80, & 315, respectively. "Effluent flow" values are the combined flows form UTB background flow (4 cfs), UTA background flow (4 cfs), and Outfall 001's reported highest monthly average flow for a period from July 2002 through April 2006. Flat Creek's resulting "effluent flow" value used in the IWC computations was 10.319 cfs. The background concentration used for Flat Creek is an average of instream dissolved minerals data collected from biological station FC-2 (upstream of the confluence with UTA tributary). Analytical laboratory reports and summarized data are provided in Appendix E. The calculated IWC for chloride, sulfate, and TDS indicated higher concentrations than the current ecoregion based water quality criteria for Flat Creek. Utilizing all the aforementioned data the IWC for Flat Creek is calculated below and summarized in Table 5.3.

$IWC_{chloride}$ =
[(4.0 cfs x 550 mg/L) + (10.319 cfs x 16 mg/L)] / (4.0 cfs + 10.139 cfs) = 165 mg/L

$IWC_{sulfate}$ =
[(4.0 cfs x 32 mg/L) + (10.319 cfs x 80 mg/L)] / (4.0 cfs + 10.139 cfs) = 67 mg/L

IWC_{TDS} =
[(4.0 cfs x 1183 mg/L) + (10.319 cfs x 315 mg/L)] / (4.0 cfs + 10.139 cfs) = 557 mg/L, say 560mg/L

Table 5.3. Instream Waste Concentration (IWC) Calculation for Flat Creek.

Parameters	Chloride	Sulfate	TDS
Ce, mg/L	16	80	315
Cb, mg/L	550	32	1183
Qe, cfs	10.319	10.319	10.319
Qb, cfs	4.0	4.0	4.0
Projected IWC (mg/L)	165	67	557

5.2.5 Computations for Haynes Creek (from confluence Flat Creek & Salt Creek to Smackover Creek)

The IWC computations for chloride, sulfate, and TDS for Haynes Creek (from confluence Flat Creek & Salt Creek to Smackover Creek) were preformed utilizing the previously calculated IWCs and flows from Flat Creek (Section 5.2.4 above) as the "effluent concentration" and "effluent flows" for each respective mineral. The "effluent concentration" for chloride, sulfate, and TDS in Haynes Creek were 165, 67, & 557, respectively. "Effluent flow" values are the combined flows form UTB background flow (4 cfs), UTA background flow (4 cfs), Flat Creek background flow (4 cfs), and Outfall 001's reported highest monthly average flow for a period from July 2002 through April 2006. Haynes Creek's resulting "effluent flow" value used in the IWC computations was 14.319 cfs. The background concentration used for Haynes Creek is an average of instream dissolved minerals data collected from Salt Creek (background flow for Haynes Creek) during 1995 & 1996 and reported in an Arkansas Department of Environmental Quality's publication "TMDL Investigation of Water Quality Impairments to Unnamed Tributary to Flat Creek Union County, Arkansas", April 1998. Summarized data form this publication is provided in Appendix E. The calculated IWC for chloride, sulfate, and TDS indicated higher concentrations than the current ecoregion based water quality criteria for Haynes Creek. Utilizing all the aforementioned data the IWC for Haynes Creek is calculated below and summarized in Table 5.4.

$IWC_{chloride}$ =
[(4.0 cfs x 1054 mg/L) + (14.319 cfs x 165 mg/L)] / (4.0 cfs + 14.139 cfs) = 359mg/L, say 360mg/L

$IWC_{sulfate}$ =
[(4.0 cfs x 6.43 mg/L) + (14.319 cfs x 67 mg/L)] / (4.0 cfs + 14.139 cfs) = 54 mg/L, say 55mg/L

IWC_{TDS} =
[(4.0 cfs x 1932 mg/L) + (14.319 cfs x 557 mg/L)] / (4.0 cfs + 14.139 cfs) = 855 mg/L

Table 5.4. Instream Waste Concentration (IWC) Calculation for Flat Creek.

Parameters	Chloride	Sulfate	TDS
Ce, mg/L	165	67	557
Cb, mg/L	1054	6.43	1923
Qe, cfs	14.319	14.319	14.319
Qb, cfs	4.0	4.0	4.0
Projected IWC (mg/L)	359	54	855

6.0 ALTERNATIVE ANALYSES

This section summarizes the analyses of alternatives for the EDCC facility to maintain the WQS for the unnamed tributary to Flat Creek, Flat Creek and Haynes Creek. As seen in Section 5.0, the discharges from EDCC maintains protective criteria related to the existing uses; however, it does not maintain the protective criteria for chloride, sulfate, and TDS related to the designated (but not existing) Domestic Water Supply uses assigned to unnamed tributary to Flat Creek, Flat Creek and Haynes Creek. In addition, the current concentration of dissolved minerals is projected to cause instream exceedances under critical flow conditions.

Six alternatives were identified to address designated uses and the protective criteria for chloride and TDS. They are as follows:

1) no action,
2) no discharge,
3) hydrograph controlled release,
4) treatment
5) source reduction/Pollution Prevention
6) Water Quality Standards modification.

6.1 No Action

This alternative would maintain the current discharge situation. However, the chloride, sulfate, and TDS effluent concentrations would be exceeded at such time that the existing final permit limits become effective (June 1, 2007). In addition, it is projected that instream exceedances of the ecoregion chloride, sulfate and TDS criteria will occur even if no additional alternative is pursued. The potential for non-compliance with the proposed final permit limits is not an acceptable alternative for EDCC or ADEQ.

6.2 No Discharge

The no discharge alternative is not a realistic alternative and is not economically feasible. Although the EDCC facility operates a treated process wastewater outfall (Outfall 001), the cost and added volume of including all storm water runoff collected throughout the facility without the continued discharge through Outfall 001 would ultimately make it economically infeasible to continue operations.

EDCC employs approximately 160 employees and 60 on-site contractors with an annual payroll estimated at approximately $9.5 million dollars. EDCC is a significant employer in Union County. The Company's annual impact on the local economy exceeds $70 million dollars. In addition, EDCC pays approximately $1.2 million in local and state taxes.

The no discharge alternative would require the cessation of operations at EDCC, an action which would greatly affect the local economy. This alternative is considered infeasible due to the socioeconomic effects to the local area.

6.3 Hydrograph Controlled Release (HCR)

The feasibility of a HCR was examined as an alternative for minimizing the impact of EDCC's discharges with elevated mineral concentrations. In EDCC's situation, an HCR system would not achieve compliance with the ecoregion dissolved minerals water quality criterion because the hydrology of the unnamed tributary to Flat Creek is impacted by limited watershed size (<2 square miles) at the mouth of the discharge tributary (UTB). The small watershed size, the urban development, and the beaver activity in the watershed has made storm water flows through the unnamed tributary to Flat Creek watershed highly variable with flash increases in response to storm events. In addition the EDCC facility comprises a large percent of the UTB watershed, further reducing the applicability for an HCR system to manage the dissolved minerals discharge for the facility. The timing of storm runoff, the development within the watershed upstream of the facility storm water discharges, and the proportion of facility storm water to watershed waters limits the application of an HCR system. The HCR discharge operational scenario is not considered to be feasible.

6.4 Treatment

EPA has no Best Available Technology (BAT) for removal of chloride, sulfate, or TDS from waste streams. While ion exchange (anion) and reverse osmosis treatment technologies exist, these methods currently are not cost effective on a large scale and are not typically recommended for treatment of storm waters prior to discharge. Also, the concentrated reject streams generated from such processes present their own unique set of potential environmental risks which can be much greater than the storm waters from which the minerals were extracted. In addition this advanced treatment places large burdens on the cost effectiveness of the facility and goods produced.

The technical limitations and uncertain environmental effects of concentrated waste streams generated from ion exchange and reverse osmosis treatment make the treatment alternative infeasible when other alternatives are considered.

6.5 Source Reduction/Pollution Prevention

The dissolved minerals in Outfall 001 are primarily contributed from process waste water and collected storm water from the site. Recent facility improvements to conserve energy resources, reduce storm water contamination, reduce and control spills, recycle process water streams, and ground water conservation activities (switching source water from Sparta ground water to surface water) have contributed to the decreases in dissolved minerals, in both the process waste water and the storm water. The facility has completed numerous site modifications and prevention activities to reduce storm water contamination as discussed in Section 3.5 (See Figures 3.4 and 3.5). Although there may be some additional incrementally small reductions, continued reductions through resource conservation is not likely to ultimately result in reductions sufficient to meet the water quality based ecoregion dissolved mineral concentration permit limits scheduled to become effective in June 2007.

6.6 WQS Modifications

The alternative to modify the dissolved mineral water quality criteria presents a viable alternative to attaining compliance with the permit limits while maintaining the existing and attainable uses. Discussions concerning the WQS modification alternative are presented below.

6.6.1 Designated Uses

As discussed in Section 3.2, the following designated uses have been assigned to unnamed tributary to Flat Creek, Flat Creek and Haynes Creek in the WQS.

UTB-Unnamed tributary to unnamed tributary to Flat Creek (above Hwy 7S)

- Secondary Contact Recreation,
- Seasonal Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

UTA-Unnamed tributary to Flat Creek (below Hwy 7S)

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Perennial Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Flat Creek

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Perennial Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

Haynes Creek

- Primary Contact Recreation,
- Secondary Contact Recreation,
- Perennial Gulf Coastal Fishery,
- Domestic Water Supply,
- Industrial Water Supply, and
- Agricultural Water Supply.

6.6.2 Existing Uses

The documented existing fishery use in unnamed tributary to Flat Creek, Flat Creek and Haynes Creek in the WQS is a seasonal gulf coastal fishery.

The primary contact recreation use was not documented as an existing use. The uses of agricultural and industrial water supply were also not documented as existing and may be limited due to water volume, but are not precluded due to water quality.

6.6.3 Attainability of the Domestic Water Supply Use

As previously noted and based on the anticipated documentation to be provided by ADH, the unnamed tributary to Flat Creek, Flat Creek and Haynes Creek are not an existing or planned public water supply source. In addition, it is anticipated that the ASWCC will verify that the removal of the designated domestic water supply use from unnamed tributary to Flat Creek, Flat Creek and Haynes Creek, does not conflict with the Arkansas Water Plan.

In addition to an evaluation of the existing and planned use of unnamed tributary to Flat Creek, Flat Creek and Haynes Creek as a domestic water supply, the USEPA Region 6 has requested that information concerning the attainability of the domestic water supply use on the basis of the regulatory criteria contained at 40 CFR 131.10(g) be included in use removal request documentation. Review of the project documentation considering the 40 CFR 131.10(g) criteria demonstrates that removing the designated, but not existing domestic water supply use is appropriate because the use is not attainable based on two of the 40 CFR 131.10(g) criteria. The first of these is criterion No. 2, which states:

> "Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met."

The unnamed tributary to Flat Creek and the Flat Creek watersheds are less than 15 square miles in size, the stream is intermittent in nature and does not have consistent base flows required to supply the volume of water necessary for the development and operation of a domestic water supply. In addition, because of the intermittent nature of the discharge from EDCC's storm water outfalls the increased flow supplied sporadically through effluent discharge is not sufficient to compensate for the small watershed size of UTB and UTA. Neither the stream system nor the discharge provides the consistent flow volume required for feasible attainment of a domestic water supply use.

The second applicable 40 CFR 131.10 (g) criterion is No. 5, which states:

> "Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses"

As demonstrated in the documentation, the physical characteristics of the unnamed tributary to Flat Creek consist primarily of shallow pools and run areas, and will not support intake and storage areas necessary for the development of a domestic water supply system. As such, the extensive physical modifications required to develop intake and storage areas would result in the removal of riparian habitat and modification of Gulf Coastal fisheries habitats. Such modifications would impact the existing aquatic life use.

6.7 Selected Alternative

Based on the historical discharge presented, the recent historical biomonitoring record, the results of the aquatic life field assessment, the mass balance modeling and the assessment of alternatives presented above, the selected alternative is to remove the domestic water supply use from sections of unnamed tributary to Flat Creek (Figure 6.1) and modify the WQS for dissolved minerals as summarized in the following tables.

Table 6.1 Summary of Proposed Modifications to designated uses for UTB, UTA, Flat Creek, & Haynes Creek.

Unnamed tributary to Flat Creek (UTB) – from EDCC 001 Discharge to the confluence with Unnamed tributary of Flat Creek (UTA)	**Unnamed tributary to Flat Creek (UTA)– from confluence of UTB to the confluence with Flat Creek**
Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use
Instream Criteria	**Instream Criteria**
Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 23 mg/L; Sulfate from 31 mg/L to 125 mg/L, and TDS from 123 mg/L to 475mg/L	Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 16 mg/L; Sulfate from 31 mg/L to 80 mg/L, and TDS from 123 mg/L to 315 mg/L

Table 6.1 (cont). Summary of Proposed Modifications to designated uses for UTB, UTA, Flat Creek, & Haynes Creek.

Flat Creek – from mouth of UTA tributary to the mouth of Haynes Creek	**Haynes Creek from confluence of Flat and Salt Creeks, downstream to confluence with Smackover Creek**
Remove Designated Domestic Water Supply Use	Remove Designated Domestic Water Supply Use
Instream Criteria	**Instream Criteria**
Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 165 mg/L; Sulfate from 31 mg/L to 67 mg/L, and TDS from 123 mg/L to 560 mg/L.	Amend ecoregion dissolved minerals criteria: Chloride from 14 mg/L to 360 mg/L; Sulfate from 31 mg/L to 55 mg/L, and TDS from 123 mg/L to 855 mg/L.

These proposed modifications are supported by the documentation which meets the requirements of AWQS Section 2.306 as stipulated in the Administrative Guidance Document.

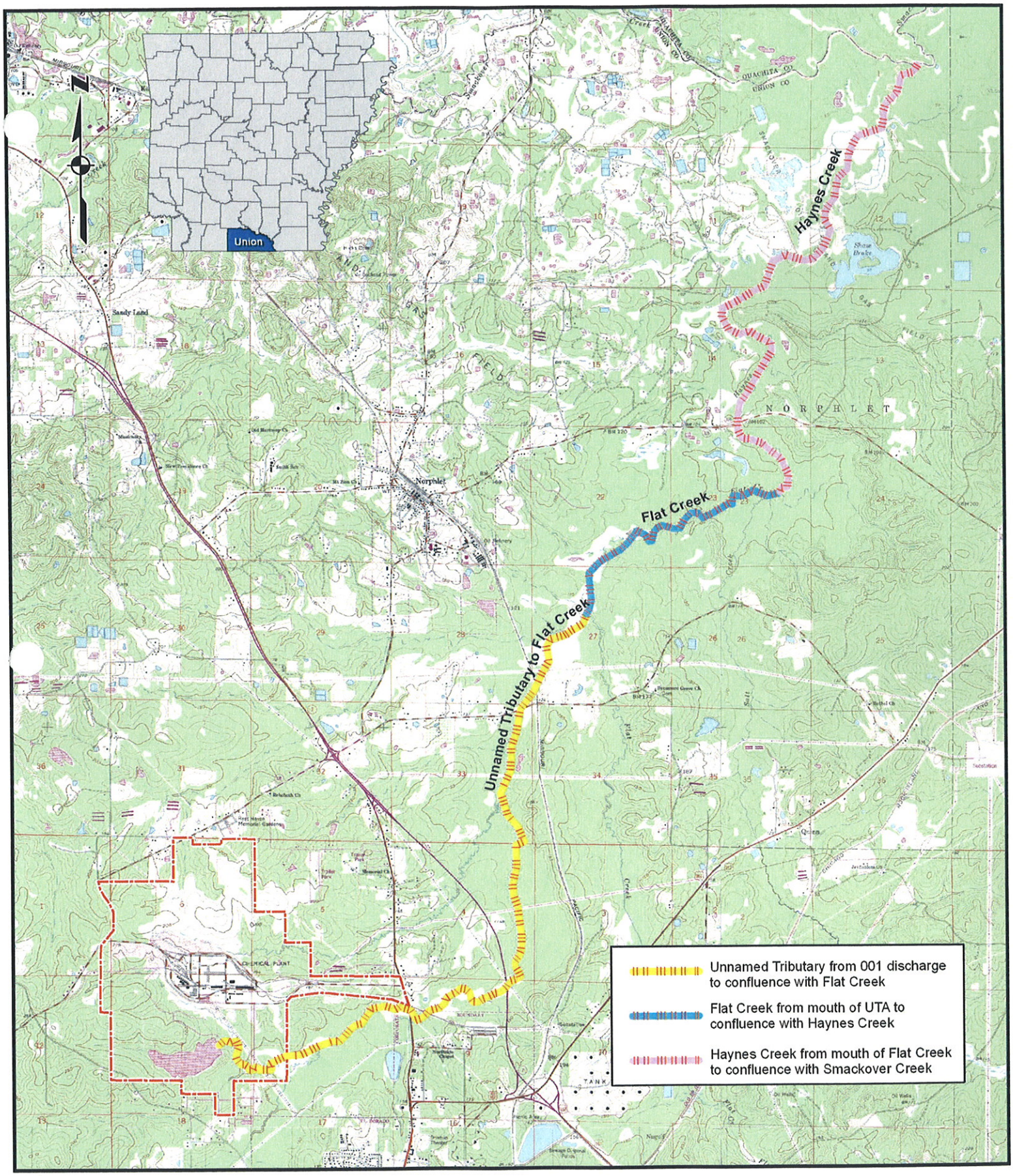

Figure 6.1. Proposed stream segments in the Haynes Creek watershed for removal of domestic water supply. EDCC 3rd party rule making. Union Co. AR. 2006.

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Appendix A

Section 2.306 [Formerly 4(g) Field Study Plan]

Section 2.306 Site Specific Water Quality Study Plan

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1.0 Introduction

1.1 Background

A third-party rule making is being developed to address the existing final permit limits for dissolved minerals in the El Dorado Chemical Company (EDCC) NPDES permit (AR0000752). The current interim permit limits are monitor and report only. During the interim period, these parameters have been demonstrated to exceed the final permit limitations. In addition, discharges of treated wastewater from Outfalls 001, may not maintain the ecoregion mineral criteria stipulated for the unnamed tributaries of the Gulf Coastal Plain ecoregion in Regulation No. 2. The intermittent discharge from discharge from Outfall 001 could exceed the current ecoregion criteria for dissolved minerals of 14 mg/L (chloride), 31 mg/L (sulfate) and 123 mg/L (total dissolved solids, TDS). These criteria were developed using an ecoregion approach and were developed based on least disturbed streams but are applied on a water body specific basis.

Currently, the dissolved solids discharged through Outfall 001 (sulfate and TDS), will not consistently meet the final permit limits of 68 mg/L and 102 mg/L for monthly average and 86 mg/L and 129 mg/L for the daily maximum, respectively. Outfall 001 discharges directly to an unnamed tributary to Flat Creek (Figure 1.1) and includes process water as well as storm water.

The final permit limits are scheduled to become effective in June 2007, unless they are modified through the third-party rule making provision of the Arkansas Water Quality Standards (Regulation No. 2). The current final dissolved mineral permit limits were developed to maintain the existing ecoregion criteria based on a long term average background flow of 4 CFS. These permit limits are also protection of the designated but non-existing and unattainable drinking water uses through the application of criteria of 230 mg/L, 250mg/L, and 500 mg/L for chloride, sulfate and TDS, respectively.

The ADEQ recognizes that the application of the dissolved mineral criteria using long term average flows (rather than Q7-10 flows) do not necessarily preclude other designated uses (fishable/swimmable) and have provided for the application of long-term flows to determine site specific instream criteria once the drinking water uses are removed. This third-party rule making is accomplished through the application of Section 2.306 [formerly 4(g)] in Regulation No. 2.

1.2 Study Objective

The objective of the study plan is to complete the field documentation required to support a third-party rulemaking in accordance with Section 2.306 to remove the designated domestic water supply use and modifying the final permit limits for dissolved minerals that will allow maintenance of existing uses.

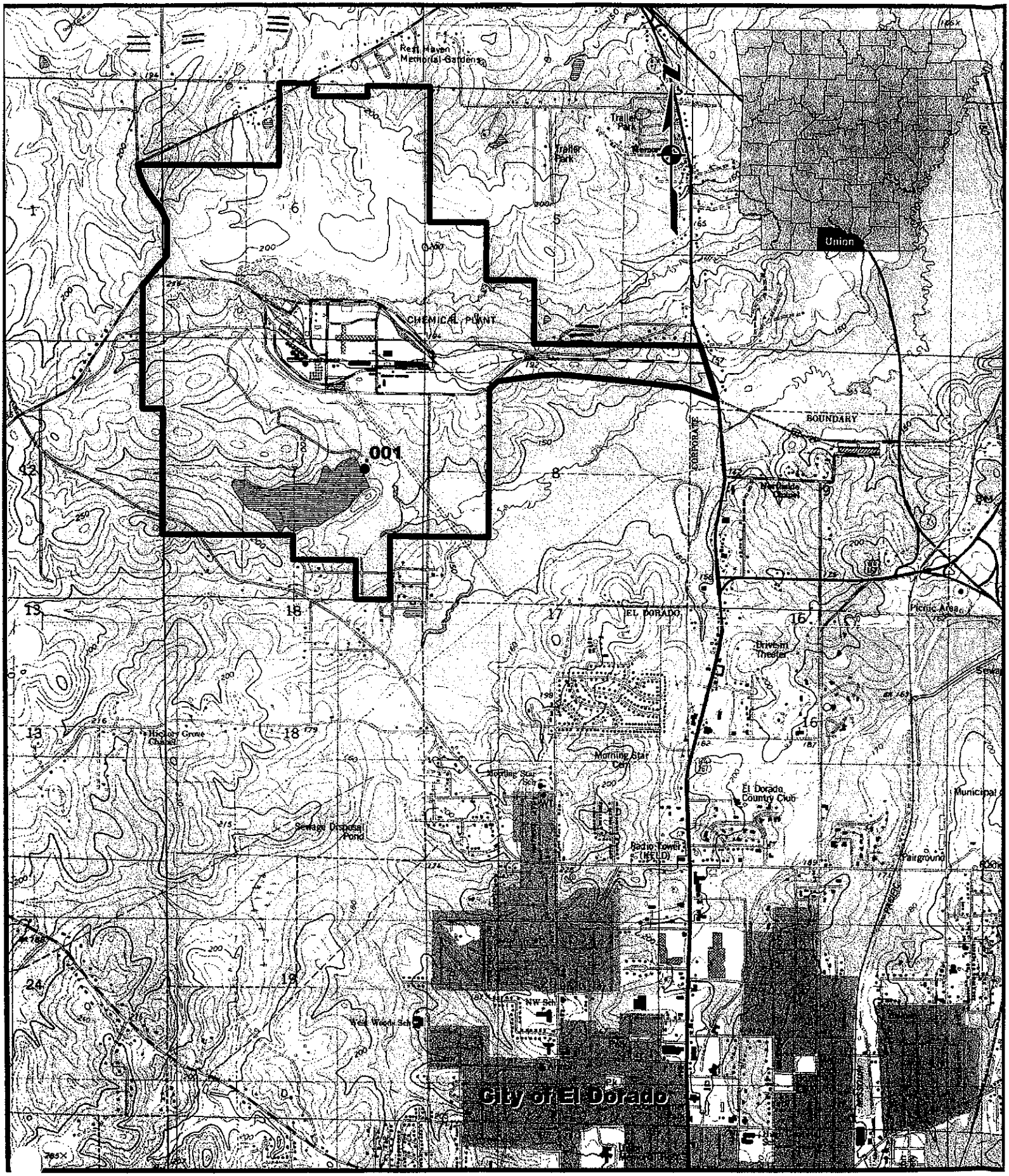

Figure 1.1. El Dorado Chemical Company property boundary and Outfall 001 location.

EDCC has developed and implemented best management practices (BMPs) to address and control storm water discharges and limit exposure of storm water. The facility is located on Highway 7S just outside the city limits of El Dorado, AR (Figure 1.1). EDCC is authorized to discharge treated process wastewater, storm water and other non-process waters under National Pollutant Discharge Elimination System (NPDES) permit No. AR0000752 into an unnamed tributary of Flat Creek. The watershed of the unnamed tributary into which EDCC discharges is less than 1 mile square at the point of discharge. The Flat Creek watershed is approximately 12 sq miles at the mouth of the UTA (Figure 1.2).

2.0 Quality Assurance/Quality Control

A complete and thorough Quality Assurance (QA) program with defined data quality objectives (DQO) is an essential part of any biological field study. The degree to which the study data meets the DQO dictates the quality and representativeness of the overall project.

2.1 Quality Control

The DQOs of this study are to attain data that meets the following quality control (QC) criteria:

1) Precision is a gauge of the ability of a measurement to be repeated acquiring similar results. The *in-situ* and analytical data will be checked for precision by use of duplicate samples at a minimum rate of 10%. An acceptable level of data precision will be based on the relative percent difference (RPD) between duplicate samples not to exceed 20%. The habitat, fish and macroinvertebrate portion of the study cannot be easily duplicated. Standard collection procedures will be used at each collection station to achieve the greatest degrees of reproducibility possible.
2) Representativeness is a gauge of the degree to which a measurement is representative of the true condition. Sampling reaches have been carefully selected as to best represent the conditions in that segment of the stream.
3) Comparability is a gauge of the ability of the resulting data to compare to data from similar measurements performed in the same study and in other studies. An effort to use standardized techniques based on EPA accepted methodologies was made to maximize comparability. Also, only experienced and trained personnel are performing the various measurements.
4) Completeness is a measure of the degrees of validity of the data collected. Completeness is evaluated by ongoing review of project data by team members to assure that all the necessary data will be collected and is reasonable.

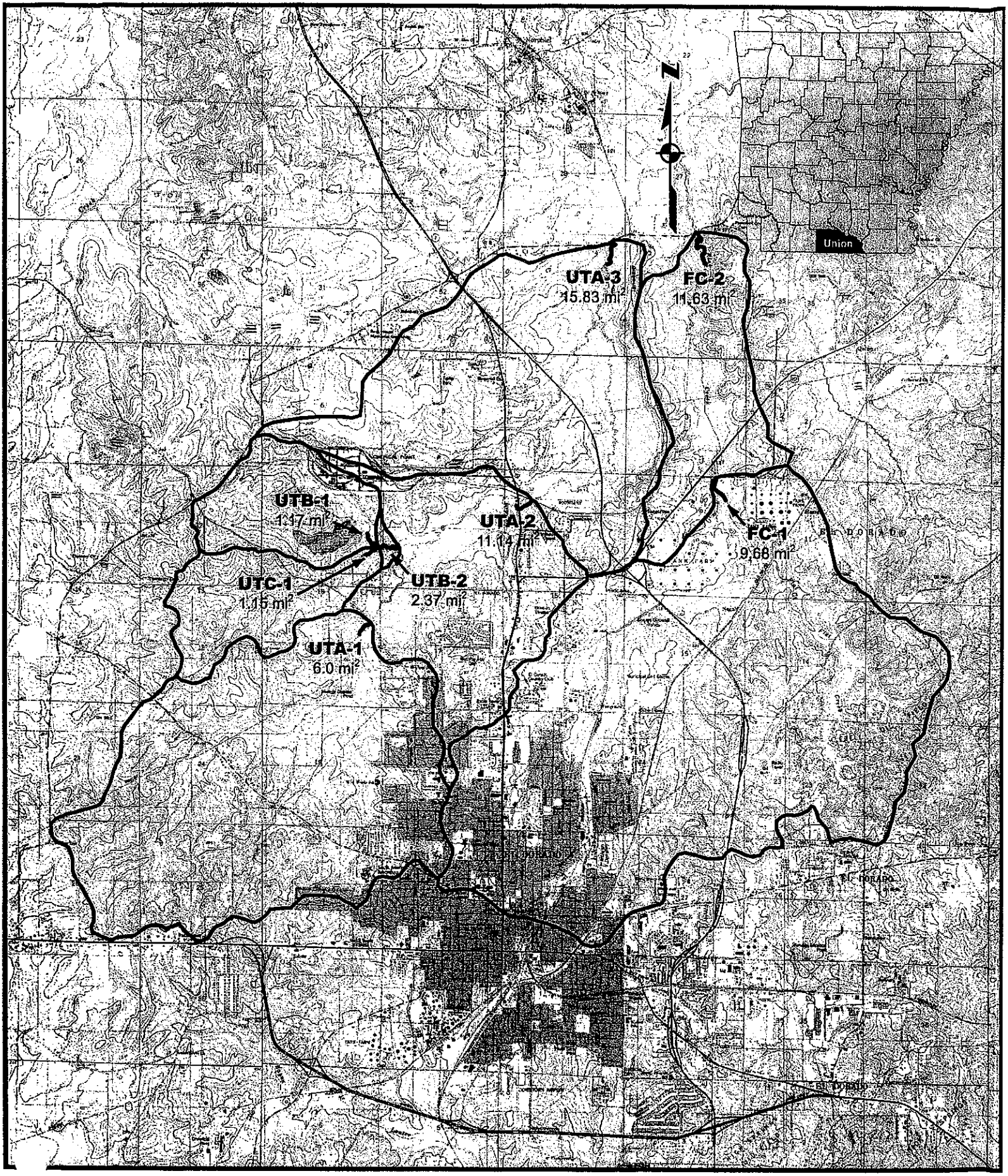

Figure 1.2. Study reaches, watershed boundaries and watershed sizes for EDCC section 2.306 aquatic life field survey. April 2006

5) Accuracy is a gauge of the degree of agreement between the measured value and the real value. Proper instrument calibrations and reference solution checks assure accuracy of *in-situ* data. All field equipment will be utilized and calibrated according to manufacturer's directions. Calibrations will be conducted daily prior to use. If any equipment fails to conform to known QA/QC manufacturers' specifications, the equipment will be replaced with duplicate equipment that will meet the specifications. Accuracy for biological collections/assessments is not quantifiable, since the true value is not known.
6) A chain of custody will be executed whenever samples are to be transferred between separate entities (e.g., water quality samples).

2.2 Field Method QC

The quality of data collected during this study will be further assured by the following QC measures:

1) A Field Equipment Checklist will be maintained and followed for all field trips. Use of the checklist helps ensure that all field equipment and forms are prepared and available for use in the field.
2) All methodologies used during this study will be based on approved and widely accepted EPA methodologies. An effort is continuously made to keep abreast of the most current methodologies and to adjust our program so as to be more comparable, representative and accurate.
3) Field data sheets are designed for each type of measurement (i.e., *in-situ,* benthos, fish, habitat, etc.). Field sheets contain the necessary information along with space to note anomalies or variances from standard procedures.
4) Trained and experienced field biologists will conduct the study. All crucial team members hold college level degrees in biological sciences or related fields. Continuing education is encouraged through short courses, scientific journal review, conference attendance, and readings in current text and manuals to assure up-to-date knowledge of the field.
5) Fish and aquatic macroinvertebrates will be identified to the lowest taxonomic level practicable. Taxonomic references will be those widely accepted in the scientific community. Identification checks will be made randomly by the project manager or other senior level scientists to verify the accuracy and of the identifications. This check will occur at a rate of approximately 10%.
6) Where analyses are quantifiable EPA approved test methods will be utilized. In these quantifiable cases MDLs will be established and adhered to along with all pertinent QC procedures (i.e., blanks, controls, spikes, and spike duplicates).

2.3 Data Review and Validation

It is necessary to establish QC guidelines for reviewing, validating, and if necessary correcting data following its measurement and analysis in the field or laboratory. This is accomplished by following the steps listed below.

1) All field record sheets, taxonomic identifications, community metrics, and analytical results will be reviewed for precision, representativeness, comparability, completeness, and accuracy.
2) When data quality problems are discovered the project manager and/or the senior scientist will determine the level of the problem and the corrective action, if any, necessary to eliminate the problem.
3) Corrective actions will vary along with the type of QC problem and the degree of the problem. Corrective action for a duplicate sample returning an RPD greater than 20% might result in a repeat of the analysis or even a repeat of the sampling event. Corrective action for a field record sheet being incomplete would likely result in a team meeting to facilitate the missing parameters being filled in correctly.

2.4 QA/QC Checks Following Each Stream Visit

Following the conclusion of all activities at each sample reach, the sample team will review all completed data forms and sample labels for accuracy, completeness, and legibility, and will conduct a final inspection of samples collected. If information is missing from the forms or labels, the team leader will make any corrections prior to proceeding to the next sample reach. The team leader will initial all data forms after review. Other team members will inspect and clean sampling equipment, inventory field supplies, prepare samples for shipment or storage as needed.

3.0 Watershed Characterization

3.1 Study Reaches

The watershed of the Flat Creek originates south of EDCC facility but within the city limits and urban development of El Dorado (Figure 3.1). The watershed size at the site of the discharge of Outfall 001 is approximately 2.2 mi^2. The total watershed of Flat Creek is less than 4 mi^2 at the mouth of UTA. As part of this third-party rulemaking, stream reaches on unnamed tributaries, both upstream and downstream of the facility and the discharge will be evaluated. As indicated by Figure 1.2, at a minimum, the individual study reaches will include:

1. UTA-1 Unnamed tributary upstream of the EDCC facility. The UTA is the receiving stream into which the Outfall 001 tributary (UTB) flows. This reach will be characterized to demonstrate the upstream condition of the UTA before mixing with the discharge from EDCC. The watershed above this location drains developed areas of El Dorado and served as a reference site utilized by ADEQ in the development of the 1998 TMDL.

2. UTB-1 This reach is located in the EDCC effluent ditch downstream of the discharge but upstream of the confluence with the UTA. This reach will be evaluated to characterize the conditions resulting from the water quality and quantity of the EDCC effluent (Figure 3.2).

3. UTB-2 The reach is located down stream of the confluence with the UTC and the mouth of UTB (the Outfall 001 effluent ditch). This reach will be characterized to demonstrate the instream condition of the UTA after the combined water quality and flows from the upstream conditions (UTA-1 and the EDCC effluent) (Figure 3.3).

4. UTC-1 The reach is located upstream of the confluence with the UTC and the mouth of UTB (the Outfall 001 effluent ditch). UTC is a 1st order intermittent tributary that contributes to UTB upstream of the confluence with UTA. This reach will be characterized to demonstrate the instream condition of the UTC before the combined water quality and flows from the upstream conditions (UTA-1 and the EDCC effluent) (Figure 3.4).

5. UTA-2 This reach is located downstream of the US Hwy 7S bridge. The watershed upstream of this location is approximately 10 square miles and represents the point at which perennial fishery use would be expected and is designated. This reach was sampled as part of the 1998 TMDL conducted by ADEQ and will provide an indication of recovery since the AMDL development (Figures 3.5 & 3.6).

6. UTA-3 This reach is located at the O'Rear Road crossing. The reach was also sampled as part of the ADEQ TMDL Survey.

7. FC-1 This reach is located on Flat creek upstream of the US Hwy 167 Bridge. The reach was sampled utilized as the reference condition for Flat Creek as part of the 1998 TMDL.

8. FC-2 This reach of Flat Creek is located just upstream of O'Rear Road and represents a least disturbed condition with a water shed that approximates that of the UTA at O'Rear road.

The physical, chemical, and biological characteristics of each of the above study reaches will be evaluated during the aquatic life field study through the implementation of the tasks as described in the following sections (4-7) of the Study Plan.

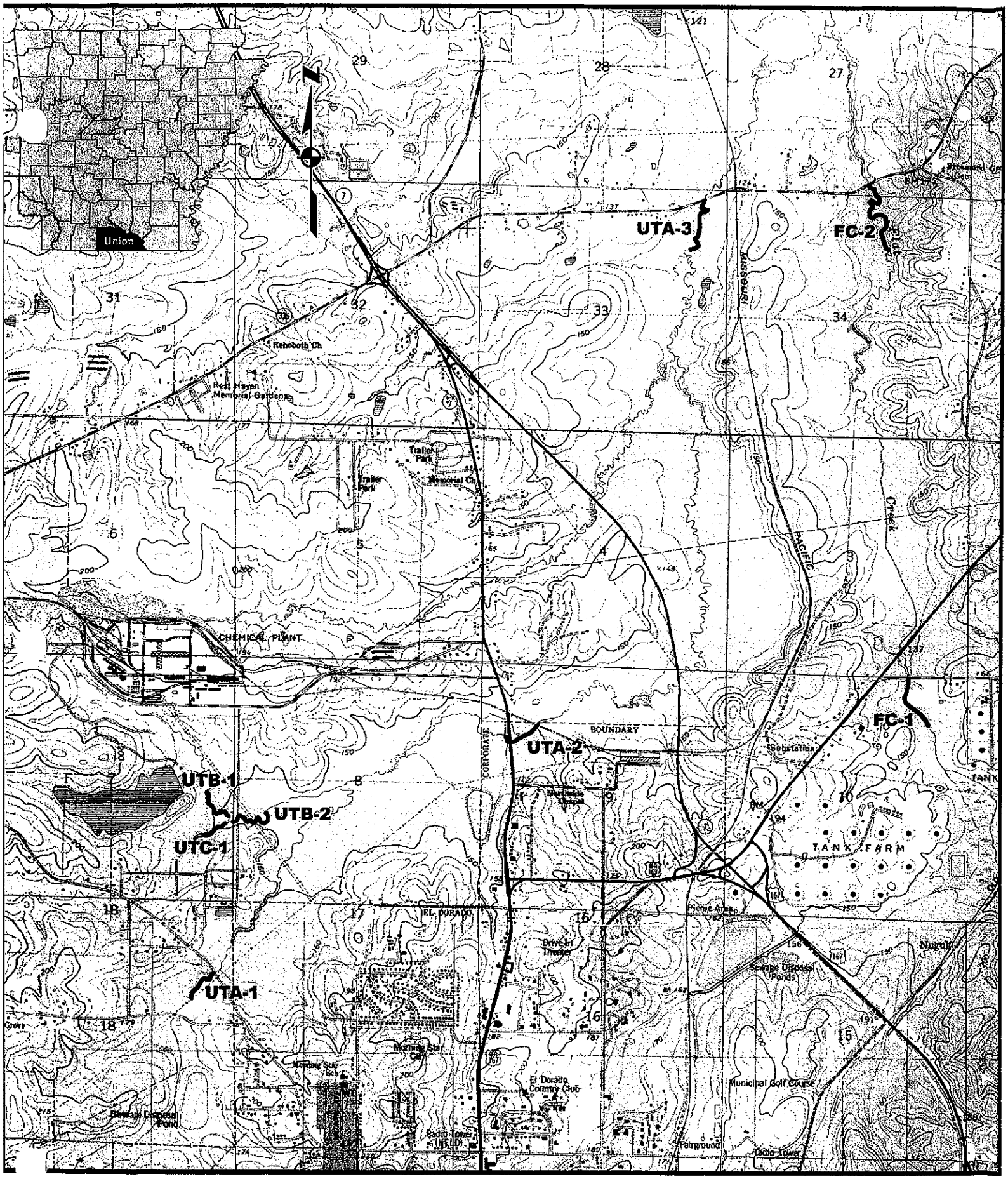

Figure 3.1. Study reaches for EDCC section 2.306 aquatic life field survey. April 2006

Figure 3.2. UTB-1, Outfall 001 effluent ditch upstream of confluence with UTC. Mach 2006.

Figure 3.5. Mid-point of Reach UTA-2 downstream of Hwy 7S Bridge (in background). March 2006.

Figure 3.3. UTB, EDCC effluent ditch downstream of confluence with UTC. March 2006.

Figure 3.6. UTA upstream of Hwy 7S Bridge. View looking downstream to south along Hwy 7S Road. March 2006.

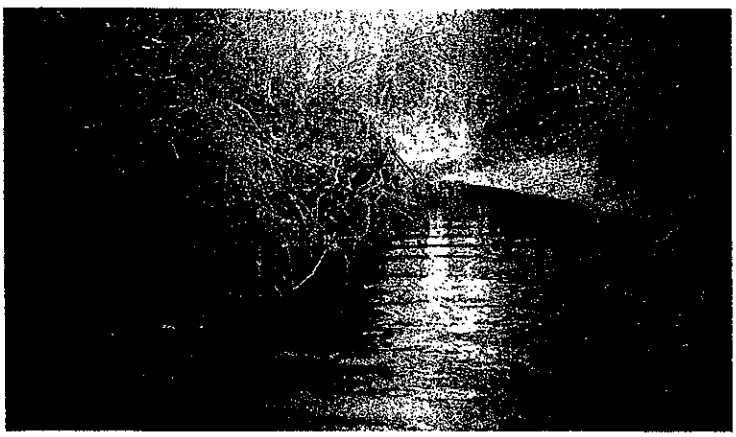

Figure 3.4. UTC, upstream of confluence with EDCC Outfall 001 effluent ditch (UTA). March 2006.

3.2 Period of Study

Due to the limited watershed size (less than 10 mi^2) of several of the study reaches and the nature of the discharge from EDCC (no discharge during critical season), data collection for the third-party rule making will occur during the spring seasonal period of the year during steady state flow conditions. It is currently proposed that field activities be completed during the month of April. Although not expected, summer time low flow sampling maybe required depending on the findings of the spring steady state condition assessment. Should summer low flow assessment be required, it would be proposed for completion during the July/August 2006 field period.

4.0 Physical Habitat Characterization

4.1 Purpose

Physical habitat in streams includes all those physical attributes that influence or provide sustenance to biological attributes, both botanical and zoological, within the stream. Stream physical habitat varies naturally, as do biological characteristics; thus, habitat conditions differ even in the absence of point and anthropogenic non-point disturbance. Within a given ecoregion, stream drainage area, stream gradient and the geology are likely to be strong natural determinants of many aspects of stream habitat, because of their influence on discharge, flood stage, and stream energy (both static and kinetic). Kaufmann (1993) identified seven general physical habitat attributes important in influencing stream ecology and the maintenance of biological integrity:

1) channel dimensions,
2) channel gradient,
3) channel substrate size and type,
4) habitat complexity and cover,
5) riparian vegetation cover and structure,
6) anthropogenic alterations, and
7) channel-riparian interaction.

Land use activities can directly or indirectly alter any and/or all of these attributes. Nevertheless, the trends for each attribute will naturally vary with stream size (drainage area) and overall gradient. The relationships of specific physical habitat measurements described in this section to these seven attributes are discussed by Kaufmann (1993). Although they are actually biological measures, aquatic macrophytes, riparian vegetation, instream habitat and canopy cover are included in this and other physical habitat assessments because of their role in habitat structure and light inputs.

The objectives of a habitat characterization are to:

1) assess the availability and quality of habitat for the development and maintenance of benthic invertebrate and fish communities, and
2) evaluate the role of habitat quality in relation to the attainment of designated uses and biological integrity.

There are three main headings for the components of the physical habitat characterization each with several categories. Measurements for each of the components (14 categories total) are recorded on copies of a two-page field form entitled Stream Habitat Assessment-Semi-Quantitative and include:

1) Channel Morphology
   a) Reach Length Determination
   b) Riffle-Pool Sequence
   c) Depth and Width Regime
2) Instream Structure
   a) Epifaunal Substrate
   b) Instream Habitat
   c) Substrate Characterization
   d) Embeddedness
   f) Sediment Deposition
   g) Aquatic Macrophytes and Periphyton
3) Riparian Characteristics
   a) Canopy Cover
   b) Bank Stability and Slope
   c) Vegetative Protection
   d) Riparian Vegetative Zone Width
   e) Land-use Stream Impacts

Field physical habitat measurements from a field habitat characterization are used in conjunction with water chemistry, temperature, macroinvertebrate and vertebrate (typically fish) community analyses, and other data sources to determine the status of the target streams attainment of designated uses and the water quality required to maintain those uses. The documentation of existing conditions are systematically tabulated using a variety of field data forms.

These procedures are intended for evaluating physical habitat in wadeable streams. The field procedures will be applied during spring seasonal conditions with steady base flows. This semi-quantitative habitat procedure will be applied in conjunction with the *General Physical Habitat Characterization* and the *Qualitative Habitat Assessment* to provide a detailed view of the streams habitat condition.

The habitat characterization protocol differs from other rapid habitat assessment approaches (e.g., Plafkin et al., 1989, Rankin, 1995) by employing a, systematic spatial sampling that minimizes bias in the placement and positioning of measurements. Measures are taken over defined channel areas and these sampling areas are placed systematically at spacing that is proportional to the length of the entire study reach. This systematic sampling design provides resolution appropriate to the length of the study

reach. The habitat assessment protocol is based on those of USEPA in their EMAP and RBP procedures (Lazorchak, 1998 and Barbour, 1999), USGS NAWQA program (Fitzpatrick, 1998) and Missouri Department of Natural Resources ESP (Sarver, 2000). The protocol is objective and repeatable and employs previously developed methods to produce repeatable measures of physical habitat in place of estimation techniques wherever possible.

Two people will complete the specified assessment, including stream flow. The actual time required to complete the habitat characterization at each monitoring location can vary considerably with channel characteristics.

The procedures are employed on a sampling reach of length equal to 20 times the bankfull width, or at least 100 yards of instream distance. The semi-quantitative habitat sampling reach length will include to the extent possible the fish and macroinvertebrate collection reaches. Measurements will be taken in each of 10 sub-reaches, which are systematically placed, at intervals equal to approximately one tenth (1/10) the length of the represented study reach. Measurements and observations for each habitat characteristic are made in each of the sub-reaches as the assessment team moves along the stream channel. An average or total of the scores for each of the 10 sub-reaches is then calculated resulting in a mean value for each characteristic for the entire reach.

4.2 Procedure

The habitat assessment will be conducted within (or to the extent possible) the stream reach from which the benthic and fish communities are to be characterized. The physical habitat will be characterized from measurements and observations of stream attributes made within 10 sub-reaches. The field team assessing habitat should move along the stream channel (near the thalwag) observing habitat characteristics within each sub-reach. A description of and the rational for measuring each of the attributes are provided below. The details of how these attributes are recorded/evaluated are also described in the GBM^c QAP.

4.2.1 Channel Morphology

Channel morphology (or geomorphology) is a characterization of the shape of the stream channel including measurements and/or visual estimates of channel dimensions and riffle-pool sequences (i.e., a measure of the amount of riffles, runs and pools that occur in a given reach).

The channel observed includes that portion of the stream between the base flow wetted area and the top of the normal high water channel often referred to as the bankfull stage (Figure 4.1). The "bankfull" or "active" channel is defined as the channel that is filled by moderate-sized flood events that typically occur every one or two years. Such flow levels are on the verge of entering the flood plain and are believed to control channel dimensions in most streams.

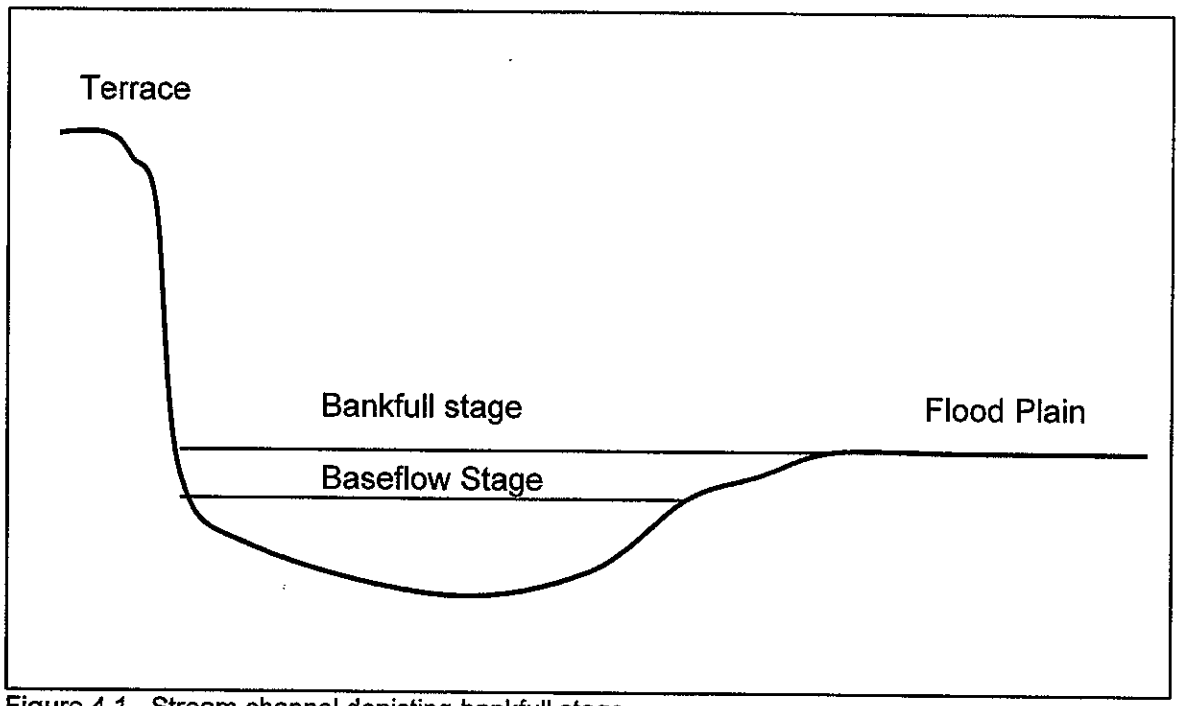

Figure 4.1. Stream channel depicting bankfull stage.

1) Reach Length Determination

First, bankfull depth (depth from stream bottom in thalwag to bankfull stage on the bank) is identified in at least two separate riffles (or alternatively runs in streams not exhibiting riffle morphology) in the study reach. Then bankfull depth and width is determined from five (5) stream transects and recorded on the record sheet. Transect locations should be selected to include each prominent morphology type represented in the stream. Bankfull depths are measured to the nearest 1/10 foot and bankfull widths are measured to the nearest foot using a wading rod and tape measure/range finder, respectively. An average of the 5 bankfull widths is then calculated and multiplied times 20 to arrive at the total reach length for assessment. This total length is then divided by ten to determine the length of each of the ten sub-reaches. Analysis of the first sub-reach should begin at the head of a given stream morphology (i.e., riffle, run or pool).

2) Riffle-Pool Sequence

Stream morphology refers to the abundance and placement (sequencing) of riffles, runs, and pools in a stream system. This sequencing is an indicator of a streams hydrological regime and stability as well as a determinant of its potential to sustain diverse aquatic communities. Beginning at the head of a morphological type (riffle, run or pool) the length of each morphological type in the stream reach should be measured using a range finder or tape measure and recorded on the record sheet. The sequence of each morphological type should be depicted on the record sheet using the provided notations so as to create a

map to the location of each riffle, run or pool. The resulting measurements should provide a quantitative measure of the percent of the study reach representing each stream morphological type (i.e., 40% riffle, 30% run, 30% pool, etc.).

3) Depth and Width Regime

The average stream depth and width will be estimated in riffles (or runs in the absence of riffles) and pools in each sub-reach. Depths will be measured along a transect, similar to that depicted in Figure 4.2, in a representative section of each riffle and pool in the sub-reach. Depths are generally taken in the thalwag (deepest area in stream channel) and approximately half way between the thalwag and the left and right banks. An estimated average depth for riffles and pools occurring in a sub-reach is derived from the cross-sectional depth measurements and recorded on the record sheet to the nearest 1/10 foot. Once completed for all 10 sub-reaches this should provide accurate semi-quantitative measurements of riffle and pool average depth and depth variability across the entire stream reach.

Stream wetted widths will be measured along a transect, in a representative section of each riffle and pool in the sub-reach. An estimated average width for each morphological type in a sub-reach should be recorded on the record sheet to the nearest foot. Once completed for all 10 sub-reaches this should provide accurate semi-quantitative measurements of riffle and pool widths across the entire stream reach.

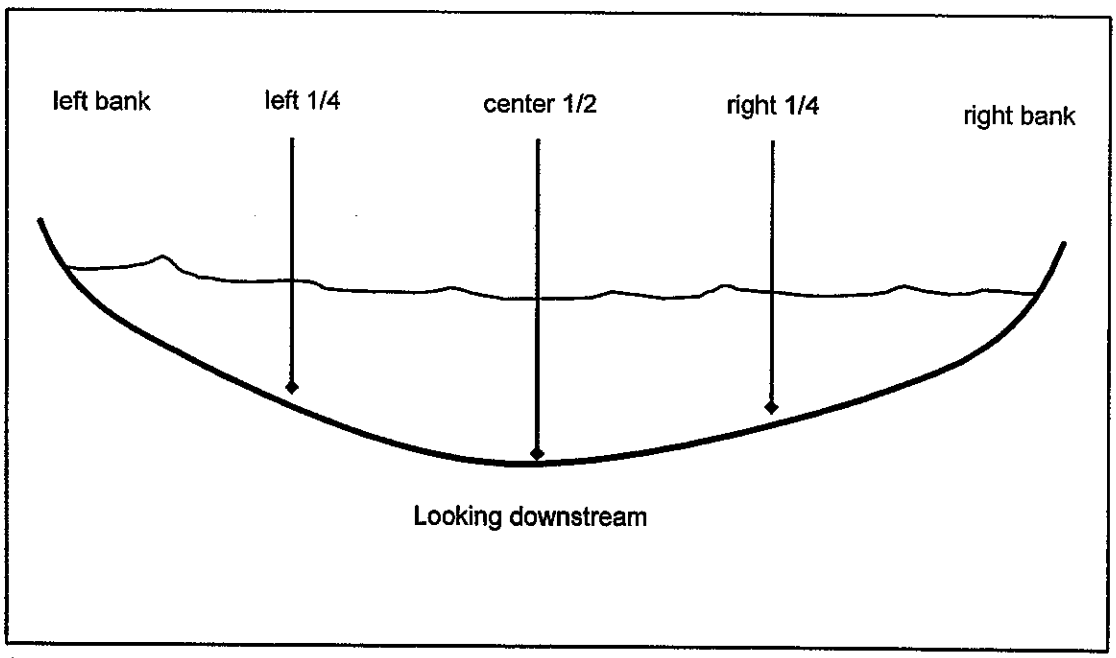

Figure 4.2. Approximate position of measurements across transect.

4.2.2 Instream Structure

Instream structure describes the characteristics of the stream within the wetted perimeter that makes up the habitat suitable for colonization of aquatic biota. This includes information about natural substrates (gravel, boulders, etc), aquatic plants and algae and debris that has been washed into or fallen into the stream, such as logs, leaves, etc. A stream capable of sustaining diverse aquatic communities will contain a variety of instream structure including some that is permanent and some that is mobile during high flow events.

4) Epifaunal Substrate (Macroinvertebrates)

Epifaunal substrate refers to the area on the bottom of the stream (entire wetted perimeter) where macroinvertebrates inhabit. This attribute is scored as a percentage of the stream bottom in a sub-reach which contains substrates suitable for macroinvertebrate colonization. Scoring for this attribute should rely heavily on the stability of the substrate, the size of the interstitial spaces, and the cleanliness (not covered in thick algae or sediment deposits) of the substrate. Cobbles and coarse gravel will score higher percentages as they contain larger interstitial spaces for colonization, while sand and silt would score lower since they provide little spaces. In addition, root wads along the bank would score higher as they are more stable features than would depositional areas or small woody debris.

5) Instream Habitat (Fish)

Instream habitat refers to the habitat features within the wetted perimeter of the stream sub-reach which are available for fish colonization. This attribute is scored as the percentage of the stream bottom (wetted perimeter) in a sub-reach which is covered with fish habitat. As with the epifaunal substrate attribute substrates composed of cobbles, coarse gravels and boulders score higher for fish cover as they provide better spaces for colonization. Other habitats that score high are large woody debris (individual logs with diameter >4 inches or complex woody structures composed of rootwads, logs, or limbs with diameter of 1.5 ft. or greater)and undercut banks. While habitats that score lower are those such as depositional areas, leaf packs, and fine sediments or sand.

6) Substrate Characterization

The dominant stream substrate size classification for riffles and pools within each sub-reach will be recorded on the record sheet. Only substrates within the wetted perimeter are evaluated. This information will be used to characterize the similarities and or differences in substrate structure and complexity in the riffles and pools of the study reach as it relates to the development and maintenance of the systems biological integrity.

Classify the particle into one of the size classes listed on the Semi-Quantitative Habitat Assessment Field Form based on the size of the intermediate axis (median dimension) of its length, width, and depth. This "median" dimension is the sieve size through which the particle can pass.

Bedrock	smooth or rough
Boulder	>25 cm
Cobble	6-25 cm
Coarse Gravel	1.6 – 6 cm
Fine Gravel	0.2 – 1.6 cm
Sand	<0.2 cm
Silt/Mud/Clay	fine, not gritty

Always make notations for unusual substrates such as concrete or asphalt and denote these artificial substrates as "other" and describe them in the comments section of the field data form. Code and describe other artificial (such as large appliances, tires, car bodies, etc.) substrates in the same manner.

7) Embeddedness

Embeddedness is the fraction of a particle's surface that is surrounded by (embedded in) sand or finer sediments on the stream bottom. By definition, the embeddedness of sand, silt, clay, and muck is 100 percent and the embeddedness of hardpan and bedrock is 0 percent.

For this attribute estimations are not made per sub-reach but for the entire stream reach as a whole. An estimation of the "percent embedded" is recorded for coarse riffle substrates in the study reach. This is accomplished by removing 12 pieces of cobble, gravel, or small boulders in at least two different riffles (three maximum) and recording the percent embedded for each. Percent embedded can be visually observed as the darkened portion of the coarse substrate that was buried in the streams fine bed material. If the darkened area covers half the coarse substrates height than the percent embedded is 50%, etc. (Figure 4.3).

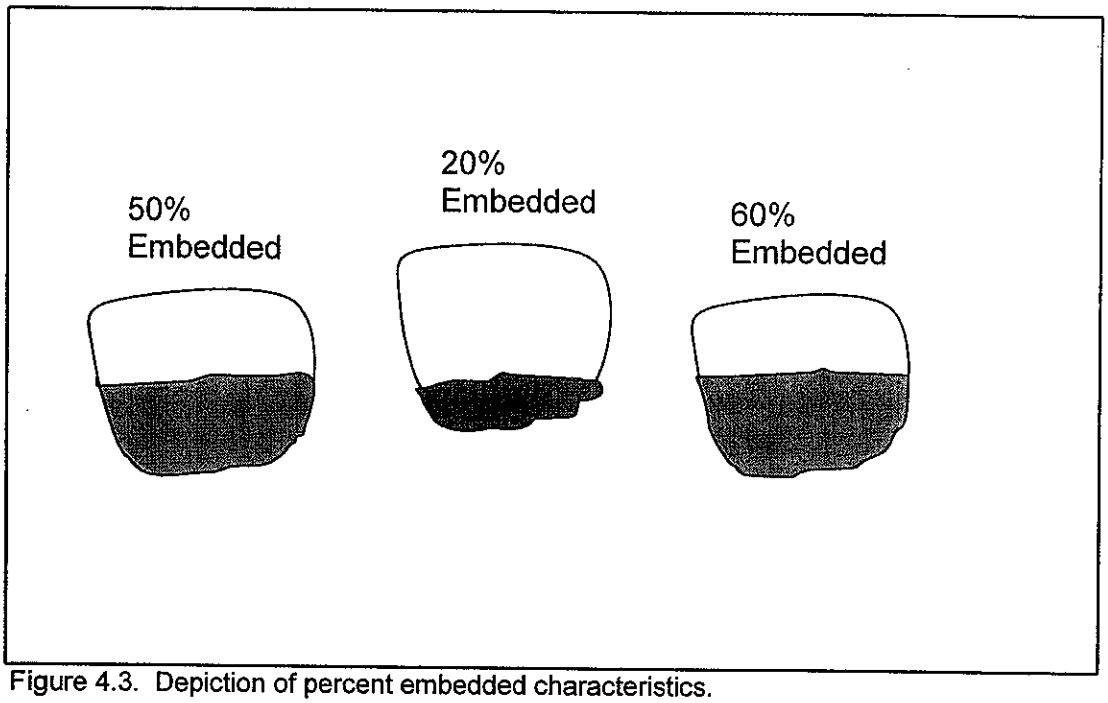

Figure 4.3. Depiction of percent embedded characteristics.

8) Sediment Deposition

The sediment deposition attribute refers to the amount of stream bottom (in the wetted perimeter) that is covered by fine sediments and/or particulate organic matter. This attribute is scored as a percentage of the bottom in each sub-reach which is covered by such loose materials.

9) Aquatic Macrophytes and Periphyton Coverage

An estimate of the percentage of area covered by macrophytes and periphyton in a sub-reach is made and recorded both for riffles and pools. Macrophytes refers to aquatic plants that grow in the stream (both emergent and submerged), and periphyton refers to algae that grows on fixed surfaces. This attribute helps biologists determine stream productivity from a nutrient enrichment perspective and also for the availability of food sources for aquatic biota.

4.2.4 Riparian Characteristics

The riparian area includes the area from the stream bank in a direction away from the stream into the upland areas. It is these stream-side riparian zones that ultimately help shape the stream and provide organic material as nutrients to the aquatic system. A well developed riparian area protects stream banks form erosion, provides shading, inputs nutrients, provides materials as habitat (instream structure) and filters runoff entering the stream. In the absence of well developed riparian zones the stream is more impacted by encroaching land-uses.

10) Canopy Cover

Canopy cover (percent stream shading) over the stream is determined for each of the sub-reaches. Estimates of cover are made by looking into the canopy over the stream channel. Estimates are made from mid-channel and each quarter channel to determine the average percent canopy cover for the width of the stream in the sub-reach. Percent canopy at each measurement point can be estimated visually or by use of a spherial densiometer.

11) Bank Stability and Slope

Bank stability is an important attribute that is an indication of a stream reaches overall hydrologic equilibrium. A bank's stability also determines its ability to provide stable habitat for biota and its propensity to release large sediment yields to the stream, which ultimately cause high turbidity and deposition in downstream reaches. The right and left banks are classified according to the following categories:

Score 9-10 = Stable, little evidence of erosion, < 5% bank eroding
Score 6-8 = Moderately stable, some evidence of new erosion, 5-29% bank eroding
Score 3-5 = Moderately unstable, obvious new erosion, 30-59% bank eroding
Score 1-2 = Unstable, most of bank actively eroding, 60-100% bank eroding

Banks composed of sands and gravels are much less stable than banks composed of silt/mud/clay or cobbles. The density of well rooted (more permanent) vegetation and root structure also help to improve a banks stability.

Average bank slope (in degrees) in a sub-reach, is recorded for each bank (left and right). Bank slope affects the stability of a bank and is an indicator of past erosion. A gentle slope may average 30° while a steep or undercut bank may average 90° or 100°, respectively.

12) Vegetative Protection

Bank vegetative protection is measured as a percent of the bank surface area which is covered by stable riparian vegetation and their associated roots in a sub-reach. Each bank (right and left) is assessed separately and the value recorded on the record sheet. Banks are assessed from the edge of the water to the top of the first terrace or normal top of bank.

13) Riparian Vegetative Zone Width

Riparian zone with encompasses the area from the top of the normal stream bank outwards into the upland area. The broader the riparian vegetative zone width the more protected the stream banks are from alteration, the fewer pollutants will enter the stream from runoff, and the more available food sources

there are to be deposited into the stream from the surrounding forest. Riparian zone width is scored for each bank in a sub-reach according to the following scale:

Score 9-10 = Riparian Zone Width > 18 meters
Score 6-8 = Riparian Zone Width 18 - 12 meters
Score 3-5 = Riparian Zone Width 11 - 6 meters
Score 1-2 = Riparian Zone Width < 6 meters

14) Land-Use Stream Impacts

Significant Alteration of the land-uses in the immediate riparian area can have detrimental affects on the stream habitat and biota. Urban and agricultural activities are often considered the more prominent of those land-uses that may impact a stream. These impacts are assessed by indicting a specific land-use impact associated with a sub-reach (on either bank) on the record sheet and assigning a degree of impact score to the land-use. The following land-use categories and impact scoring system are provided:

Land-uses:
C = Cattle
R = Row crops
U = Urban encroachment
I = Industrial encroachment
O = Other (noted on field form)

Scoring:
0 = no land-use impacts
1 = minor impacts
2 = moderate impacts
3 = major impacts

4.3 Scoring and Analysis of Habitat Assessment Data

Scores from the Semi-Quantitative Habitat Assessment can be utilized in two different ways. First, data collected for each attribute (assessment category) can be used independently to describe the study reach collectively. This method results in information such as: average riffle depth, average pool width, percent riffle in entire reach, average bank stability, average (median) substrate size class in pools and riffles, mean percent canopy cover, etc. Second, the data collected during the assessment can be used in conjunction with the Qualitative Habitat Assessment procedure to score each of the ten "qualitative" indices with near quantitative accuracy (semi-quantitative). A combination of the two methodologies should be incorporated into all intensive aquatic biota field studies where habitat assessment accuracy and repeatability is critical. The following sections outline the scoring of the qualitative habitat indices using the semi-quantitative data.

4.3.1 High Gradient (riffle-pool stream complexes)

1) Epifaunal Substrate / Available Fish Cover

Average values from semi-quantitative categories 4 (Epifaunal Substrate) and 5 (Instream Habitat) are combined into an overall average percent coverage and used to score this metric.

The following table presents the scoring criteria:

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Coverage	>70%	40%-70%	20%-39%	<20%
Score	20 -16	15 -11	10 - 6	5 - 1

2) Embeddedness

Reach average percent embedded (from category 7) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Embedded	<25%	25%-50%	49%-75%	>75%
Score	20 -16	15 -11	10 - 6	5 - 1

3) Velocity / Depth Regime

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) along with flow and velocity data collected in the reach is used to score this metric. Use the following table to determine which regimes are present:

Rank	Slow-deep	Slow-shallow	Fast-deep	Fast-shallow
Velocity	<1 fps	<1 fps	>1 fps	>1 fps
Depth Regime	>1.6 feet	<1.6 feet	>1.6 feet	<1.6 feet
Typical Morphology	Deep pool	Shallow pool	run	riffle

If a reach has deep and shallow pools, and distinctive run and riffle morphology, then you have at least three regimes and possible all four regimes. Score each rank lower if shallow regimes are the missing regimes. Scoring is applied as per the following table.

Rank	Optimal	Sub-Optimal	Marginal	Poor
No. Regimes	Four regimes present	Three regimes present	Two regimes present	One regime present
Score	20 -16	15 -11	10 - 6	5 - 1

4) Channel Alteration

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

5) Sediment Deposition

Reach average percent bottom affected by deposition (from category 8) is used directly to score this metric.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Bottom Affected	<5%	5%-30%	31%-50%	>50%
Score	20 -16	15 -11	10 - 6	5 - 1

Utilize the lower end of each scale to represent reaches where recent sediment bar formation is evident.

6) Frequency of Riffles

Using semi-quantitative category 3 (Depth and Width Regime) the average width of the stream is determined as the average of riffle and pool widths combined. Using category 2 (Riffle-Pool Sequence) the distance between riffles can be calculated using the sequencing notations and the morphological lengths. The table presented below should be used to develop scores for this metric.

Example: a reach with an average width of 18 feet, with 4 riffles separated by a 50 foot pool, a 20 foot run, and a 100 foot pool would result in an average distance between riffles of 57 feet. Therefore, the ratio = 57/18 = 3.2 and would rank as Optimal (score @ 18).

Rank	Optimal	Sub-Optimal	Marginal	Poor
Ratio (distance between riffles : stream width)	<7 : 1	7 – 15 : 1	16 -25 : 1	>25 : 1
Score	20 -16	15 -11	10 - 6	5 - 1

In continuous riffle streams the consistent placement of boulders and logs provides scores in the highest range of the optimal category.

7) Channel Flow Status

Scored from visual assessment of entire reach. Not aided by semi-quantitative attributes.

8) Bank Stability

The average bank stability score for each represented bank from the semi-quantitative assessment (category 11) is directly applied to the qualitative assessment scoring for this metric (i.e., an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

9) Vegetative Protection

Reach average percent bank protected (from category 12 of the semi-quantitative record sheet) is used directly to score this metric for the right and left bank.

Rank	Optimal	Sub-Optimal	Marginal	Poor
% Protected	>90%	70% - 90%	50% - 69%	<50%
Score	20 -16	15 -11	10 - 6	5 - 1

10) Riparian Vegetative Zone Width

The average riparian zone width score for each represented bank from the semi-quantitative assessment (category 13) is directly applied to the qualitative assessment scoring for this metric (i.e., an average reach score of 8 for the right bank and 7 for the left bank gets transferred directly to the qualitative score sheet as such.)

4.3.2 Alternative Metrics for Low Gradient Streams (pool dominated complexes)

The individual metrics with alternatives for pool dominated stream complexes includes 2, 3, and 6, and are described as follows:

2) Pool Substrate Characterization (replacement for Embeddedness)

Using the Substrate Characterization data from the semi-quantitative assessment (category 6) and the aquatic vegetation assessment (category 9) the following table may be used to score this metric.

Rank	Optimal		Sub-Optimal	Marginal	Poor
Substrate	Cobble or Gravel		Sand/Silt/Clay	Sand/Silt/Clay	Bedrock or Clay Only
Macrophytes Present	Yes	No	Yes	No	No
Score	20 - 18	17 - 16	15 - 11	10 - 6	5 - 1

3) Pool Variability (replacement for Velocity/Depth Regime)

Semi-Quantitative categories 2 (Riffle-Pool Sequence) and 3 (Depth and Width regime) are used to help score this metric. Use the following table to determine pool variability.

Pool Characteristic	Large-Deep	Large-Shallow	Small-Deep	Small-Shallow
Size	Length ≥ Width	Length ≥ Width	Length < Width	Length < Width
Depth	≥3.2 feet	< 3.2 feet	≥3.2 feet	< 3.2 feet

An equal balance of all four pool types achieves higher scores. A prevalence of shallow pools scores lower.

6) Channel Sinuosity (replacement for Frequency of Riffles)

This metric is assessed separately from the semi-quantitative data. It can be estimated in the field, measured during a longitudinal survey or calculated from current aerial photographs.

5.0 Water Quality

During the field study, water quality will be documented through *in-situ* measurements and sampling for laboratory analyses at each of the study reaches as identified in Section 3.1. The following sections present the parameters and documentation methods.

5.1 *In-situ* Measurements

The following parameters will be monitored at each of the study reaches:

1) temperature, C°
2) dissolved oxygen, mg/L
3) conductivity, µS
4) pH, su
5) flow, cfs

In accordance with Section 2.0 calibration will be performed and documented according to the manufacturer's recommendations.

The *in-situ* measurements are recorded on the second page of the Field Data Form. Other information recorded on the Field Data Forms will include:

1) general station location information,
2) the field crew completing the assessment,
3) current hydrologic conditions,

4) antecedent moisture conditions, and
5) identification of the meters utilized.

5.2 Water Chemistry

Grab samples for laboratory analysis of chloride, sulfate, TDS, and nitrates will be collected at each sample reach at the same time as *in-situ* measurements are obtained and in connection with the biotic assessment. In addition a single water quality collection set will be completed within a single 12 hour period to obtain a "snap shot" of the water quality as discharge occurs. This effort will coincide with the collection of effluent for a quarterly biomonitoring compliance at EDCC. Analytical results from the laboratory will be retained for use in project documentation. The instream concentrations will also be utilized in the development of the site specific water quality criteria for each receiving stream.

Water quality data will be utilized in conjunction with EDCC effluent data (most recent two year period of record), to model instream concentrations of the dissolved minerals and nitrate. In addition this data will be used to model and project instream waste concentrations required to maintain the attainable and existing uses as maintained by the historical discharge conditions.

5.3 Summary of Historical Water Quality.

The historical water quality of the receiving stream and the historical effluent water quality parameters will be will be evaluated and summarized to demonstrate compliance with existing water quality criteria. This evaluation will include an assessment of biomonitoring results and requirements to support the existing biotic communities and the attainable designated uses.

6.0 Benthic Macroinvertebrate Community

6.1 Introduction

The benthic macroinvertebrate protocol utilized in these field studies is intended to evaluate the biological integrity of wadeable streams for the purpose of detecting stresses on community structure, assessing the relative severity of these stresses, and determining the maintenance of the designated uses. The approach is based on the "Rapid Bioassessment Protocol III–Multi Habitat approach using an aquatic dip net as published by the U.S. Environmental Protection Agency (Barbour, M.I. et al., 1999) as adapted for use in pool dominated streams of the Gulf Coastal Plain Ecoregion.

The rapid bioassessment protocol is the preferred macroinvertebrate collecting method for pool dominated streams. The U.S. Geological Survey utilizes a similar

approach for their National Water-Quality Assessment Program (NAWQA; Cuffney et al., 1993). During this Project, the benthic community of each of the reaches described in Section 3.1 will be evaluated utilizing the rapid bioassessment protocols.

In response to the impact of habitat diversity and the variety of in stream habitat associated with the individual study reaches, artificial substrate will be deployed into the study reaches and allowed to colonize for a six week period (Figure 6.1). At the end of the colonization period, the artificial substrates will be collected, processed and the invertebrate community characterized using both semi-qualitative diversity measures and a quantitative assessment. The application of the artificial substrate removes the habitat variable and allows an assessment of the impact of the water quality in relation to the development of the benthic community assemblage.

6.2 Methods

Qualitative samples of the benthic macroinvertebrate assemblage will be collected over a predetermined period of time using an aquatic dip net and sampling all available microhabitats present within the stream reach.

Each station will be sampled for three minutes according to the RBA protocol. Each sample will be placed in a bucket and condensed with a series of washings through a series of sieves, the smallest of which will be a U.S. Standard #30 sieve.

The artificial substrate at each location will consist of a rock filled basket and /or a Hester-Dendy plated substrate. The artificial substrates will be deployed, and available of insect colonization for a 6 week period after which they will be retrieved and processed to identity the diversity and the quantity of invertebrate community. The artificial substrate will provide a comparison of invertebrate community development potential as allowed by the existing water quality and allow comparisons that are not impacted by variable habitat, but by water quality alone.

6.3 Sample Processing

6.3.1 Rapid bioassessment

Random sub-samples of the concentrated sample will be placed on a white sorting tray from which the macroinvertebrates will be removed. A 100 organism sub-sample will be randomly picked (according to the standardized RBA procedures) from the tray and field identified to the lowest possible taxon.

6.3.2 Artificial substrate samples

After a six week exposure period, the artificial substrates will be collected, insects removed either by repeated washings and/or manually. The insects will be preserved and a 100 organism sub-sample collected at random for identification. In addition, the numerical abundance of the colonized community will be determined either by a complete count or a volumetric estimation technique depending on the density of the colonization.

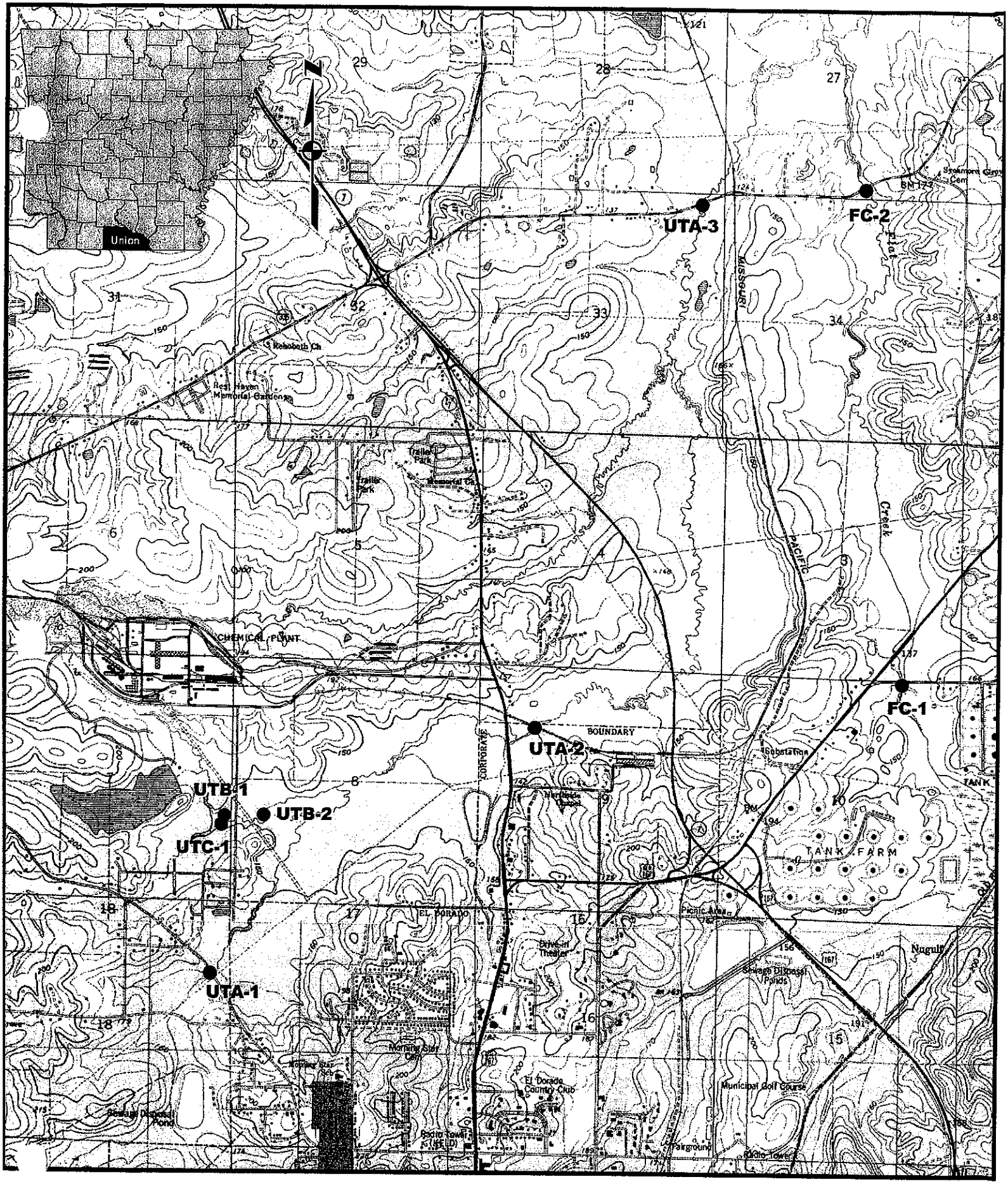

Figure 6.1. Proposed locations for deployment of Artificial Substrate to monitor aquatic invertebrate community for EDCC section 2.306 aquatic life field study. April 2006

6.3.3 Taxonomic Assemblage

The 100 organism sub-samples of both techniques will be preserved in 70% ethanol or Kayles solution for lab verification of field identifications and as a voucher to be used if more detailed analysis becomes necessary. Laboratory verification will be accomplished using general keys including but not limited to Merritt & Cummings, (1996); Pennak, (1989), and Unsinger (1963). In addition more taxa specific keys such as Mayflies of North and Central America (Edmunds et. al., 1976), Dragonflies of North America, (Needham & Westfall, 1975) or keys developed specifically for Arkansas may be utilized for the laboratory verification of the field identifications.

After the 100 organism random sample is collected, labeled and preserved, the larger debris items (e.g., leaves, sticks, rocks, etc.) in the collected sample will be examined for clinging benthic macroinvertebrates. Any organisms will be removed prior to the larger debris being discarded. The remainder of the original sample not utilized in the selection of the 100-organism sub-sample will be concentrated and retained as a voucher for the sample picking techniques used. The voucher samples will be preserved with 70% ethanol or Kayles solution. These voucher samples will be held at GBM^c for a period of 24 months following the conclusion of the third party rulemaking at which time the samples may be submitted to an academic zoological collection. The macroinvertebrate assemblages from each station will be analyzed according to several benthic community biometrics. These will include richness (number of different taxa), EPT richness (number of different taxa represented in the orders Ephemeroptera, Plecoptera, and Trichoptera), and species diversity as determined by the Shannon-Wiener Diversity Index.

The analysis will also include the seven biometrics used by the State of Arkansas (ADPCE, 1988) in their RBA scoring system. This scoring system places a value (1 to 4, 1 = excessive differences, 4 = no differences) on each of the seven biometrics to achieve a final mean score. The biometric scoring will indicate the impacts to a benthic community when compared to the benthic community of different reaches, to demonstrate effects of point and or non-point source contributions between reaches.

For each study site, a complete tabulation of taxa, numbers of individuals and their percent composition will be included on the two-page field data sheets – Benthic Macroinvertebrates. The first page of the two-page data form will include general information identifying the sample reach and investigators as well as site observations to include:

1) time sampled,
2) relative abundance of aquatic tropic level communities,
3) percent of major habitats sampled,
4) percent of specific microhabitats sampled, and
5) relative abundance of the ordinal groups observed during sample collection.

The second page provides for the listing of the taxa comprising the 100 organism sub-sample and the field identifications and the numbers of each. Also included on page 2 are the general reach identifiers and preliminary summary sections to be used in the application of selected biometric scoring criteria.

7.0 Fish Community

7.1 Introduction

The fish community supported in a stream is in direct response to available habitat, food sources, and water quality of that particular stream. The presence of a certain level of species richness and diversity along with a community structure similar to that expected in typical streams of the ecoregion are indicators of aquatic ecosystem health.

The objective of the fish community characterization is to collect and identify a representative sample of all except very rare species in the assemblage reflective of the relative abundance within the community assemblage. Backpack electrofishing equipment will be used as the principal sampling gear supplemented by block netting and seining in habitats where flow, substrate and structure affect capture of benthic species. All team personnel will be involved in collecting fish.

Although most of the receiving streams into which the discharges occur are a fraction of the 10 square mile threshold for perennial fish community maintenance, the fish community of the reaches described in Section 3.1 will be evaluated during this project:

7.2 Methods

Major factors that influence collecting include flows, water depth, instream obstructions, water turbidity, temperature and conductivity. The primary tool utilized in the fish collections will be a Smith-Root backpack electroshocker. However, seines and block nets may be utilized as necessary to adequately characterize the reaches indicated.

Sampling fish species to determine their proportionate abundance will be conducted after all water quality parameters and/or samples are collected but prior to the collection of the benthic and habitat data as described in Sections 4 and 5.

Shocked fish will be captured with hand held dip nets and held in buckets while the sampling continues throughout the reach. The entire channel within the sampling reach will be sampled. Actual shocking time will continue for not less than 30 minutes unless the wetted habitat area of any reach is too small for 30 minutes of shocking time. The shocker is equipped with an automated timing mechanism which records the amount of time that electricity is actually being applied, or "pedal down time" (PDT). In addition to PDT, the total collection time will be recorded. There will not be a maximum time limit for the collection period, however the collections may be terminated when the principal investigator determines that additional collection time will not likely result in additional fish species. Sampling information will be recorded on the Field Data Sheets-Fish. General comments (perceived fishing efficiency, missed fish, and gear operation suggestions) will be recorded on the lines provided on the form.

An effort to search for and collect fish will be completed at all reaches, even if the stream is extremely small, and it appears that sampling may not collect any specimens.

7.3 Sample Processing

Following collection, each sample of fish from a reach will be preserved in formalin for later processing. Sample processing will involve tallying and identifying fish, examining individual specimens for external anomalies, preparing voucher specimens for taxonomic confirmation and archival at a museum.

For each study site, a complete tabulation of taxa, numbers of individuals and their percent composition will be included on the two-page Field Data Sheets – Fish. The first page of the two-page data form will include general information identifying the sample reach and investigators as well as site observations to include:

1) time sampled,
2) Pedal Down Time (PDT),
3) relative abundance of aquatic tropic level communities,
4) percent of major habitats sampled,
5) percent of specific microhabitats sampled, and
6) relative abundance and scoring of substrate.

Ultimately, the fish identification will be verified in the lab using keys in the Fishes of Arkansas (Robison and Buchanan, 1988) and the Fishes of Missouri (Pflieger, 1975) to species level where possible.

The fish collections at each reach will be compared according to several biometrics including: species richness (number of taxa); sunfish richness; species diversity; abundance; dominant ordinal groups; percent of tolerant species; trophic structure; percent of hybrids; percent of diseased fish; and key indicator species as listed in Regulation No. 2 of the ADEQ.

In addition, the fish assemblage will be evaluated utilizing the fish community biocriteria and a comparison to typical Gulf Coastal Ecoregion least disturbed streams. The fish community biocriteria scoring was developed by the ADEQ and uses eight metrics to determine use support status.

8.0 Study Schedule

The following table provides an overview of the schedule anticipated to facilitate the proposed 3rd party rule making for EDCC.

Task	Description	Anticipated Schedule
Phase 1		
Task 1	Work Plan development	March 20 – April 7, 2006
Task 2	Field Documentation	April 15 - June 15, 2006
Task3	Data evaluation & modeling	June 1 - September 31, 2006
Task 4	Project reporting	October 1 - December 31, 2006
Phase 2		
Task 5	Rulemaking coordination	January 1- June 2007
Task 6	NPDES permit modification	June 2007

8.1 Field Study and Documentation of Existing conditions

The spring seasonal biotic characterizations will be completed during April/ May 2006. This period corresponds to the seasonal fishery period as stipulated in ADEQ seasonal fishery designation. Depending on the results of the seasonal assessment, additional field activities may be required under summer low flow conditions at those sites which have watersheds greater than 10 square miles.

8.2 Data Assessment and Criteria Development

The status of existing biotic conditions and the development of the proposed criteria to support the seasonal fisheries use will be completed during the period form June – September 2006. Should the information developed during the seasonal aquatic life study require increased level of documentation due to the perennial fisheries use designation, additional field studies may be completed during summer low flow conditions (July & August 2006) in Study reaches that have a perennial fishery designation.

8.3 Report submittal and request for 3rd Party Rulemaking

The documentation supporting the initiation of the 3rd party rule making process will be submitted for staff review by November 15, 2006. After the 30 day review period, the documentation will be submitted to the ADEQ Commission for Rule making.

9.0 References

Barbour, M.T. 1999. Rapid Bioassessment Protocols for use in wadeable streams and rivers. 2nd Edition USEPA 841-B-99-002.

Cuffney, T.F., M.E. Gurtz, and M.R. Meador. 1993. Methods for Collecting Benthic Invertebrate Samples as Part of the National Water-Quality Assessment Program. U.S. Geological Survey Open-File Report 93-406, Raleigh, North Carolina.

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Merritt, R.W. and K.W. Cummins. 1984. An introduction to the aquatic insects of North America (Second edition). Kendall/Hunt Publishing Company, Dubuque, IA 52001.

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Pennak, R.W. 1989. Freshwater invertebrates of the United States – Protozoa to Mollusca (Third edition). John Wiley and Sons, Inc., New York, NY. 628 pp.

Pflieger, W.L, 1975. Fishes of Missouri. Missouri Department of Conservation. 343pp.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89/001. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Washington, D.C.

Robison, H.W. and T.M. Buchanan, 1988. Fishes of Arkansas. University of Arkansas Press. 536 pp.

Unsinger, R.L. 1963. Aquatic insects of California with keys to North American genera and California species. University of California Press, Berkley, CA.

U.S. Environmental Protection Agency (EPA). 1983. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses.

Appendix B
Agency documentation

Arkansas Natural Resources Commission

J. Randy Young, PE
Executive Director

101 East Capitol, Suite 350
Little Rock, Arkansas 72201
http://www.anrc.arkansas.gov/

Phone: (501) 682-1611
Fax: (501) 682-3991
E-mail: anrc@arkansas.gov

Mike Huckabee
Governor

August 8, 2006

Mr. Vince Blubaugh
Principal, CBM[c] & Associates
219 Brown Lane
Bryant, Arkansas 72022

RE: Review and Comments
Removal of Designated Domestic Water Supply Use from
ELCC Tributary of Flat Creek, Flat Creek and Haynes Creek
in Union County, Arkansas

Dear Mr. Blubaugh:

Thank you for the opportunity to review and comment on the removal of the Designated Domestic Water Supply Use from an unnamed tributary of Flat Creek, Flat Creek and Haynes Creek to its confluence with Smackover Creek in Union County, Arkansas. This unnamed tributary appears to be ELCC Tributary, as identified on various ADEQ listings.

The removal of the Designated Domestic Water Supply Use from these reaches of Haynes Creek and its tributaries above Smackover Creek would not conflict with the Arkansas State Water Plan. If you need any further assistance, or have any questions, please contact Steve Loop at (501) 682-3959.

Sincerely,

Earl T. Smith, P.E., Chief
Water Resources Division

Arkansas Department of Health and Human Services

Division of Health

Paul K. Halverson, DrPH, Director

Engineering Section – Environmental Health Branch – Center for Local Public Health

Postal Address	P. O. Box 1437, Slot H-37	Little Rock, AR 72203-1437	1-501-661-2623	TDD: 1-800-234-4399
Physical Address for UPS or Fedex	4815 West Markham St., Slot H-37	Little Rock, AR 72205		Fax: 1-501-661-2032

July 24, 2006

Vance Blubaugh
GBM[c] & Associates
219 Brown Lane
Bryant, AR 72022

Re: Domestic Water Supply Determination – Flat & Hayes Creek
GMB[C] No. 2042-06-070
Your letter dated June 21, 2006

Dear Mr. Blubaugh,

Unnamed Tributaries of Flat Creek, Flat Creek and Hayes Creek near El Dorado, Arkansas, have not been approved and are not being considered for use as a public water source.

Questions on whether these stream are used as a water source by private individuals should be directed to the Union County Sanitarian.

If there are any questions please contact me at 501.661.2623.

Sincerely,

Robert Hart
Chief Engineer
Engineer Section

RH:DT:WCH:wch

CC: Union County Sanitarian

219 Brown Lane Bryant, AR 72022 (501) 847-7077 (501) 847-7943 fax

June 21, 2006

Mr. Earl T. Smith
Chief Water Management Division
Arkansas Soil and Water Conservation Commission
101 East Capital, Suite 350
Little Rock, AR 72201

Re: Domestic Water Supply Determination
GBM^c No. 2042-06-070

Dear Mr. Smith:

GBM^c & Associates is developing documentation, pursuant to the Arkansas Water Quality Standards, to evaluate removal of the Designated Domestic Water Supply Uses from an unnamed tributary of Flat Creek, Flat Creek and Haynes Creek near El Dorado, Arkansas. Please see the attached map of the stream reaches.

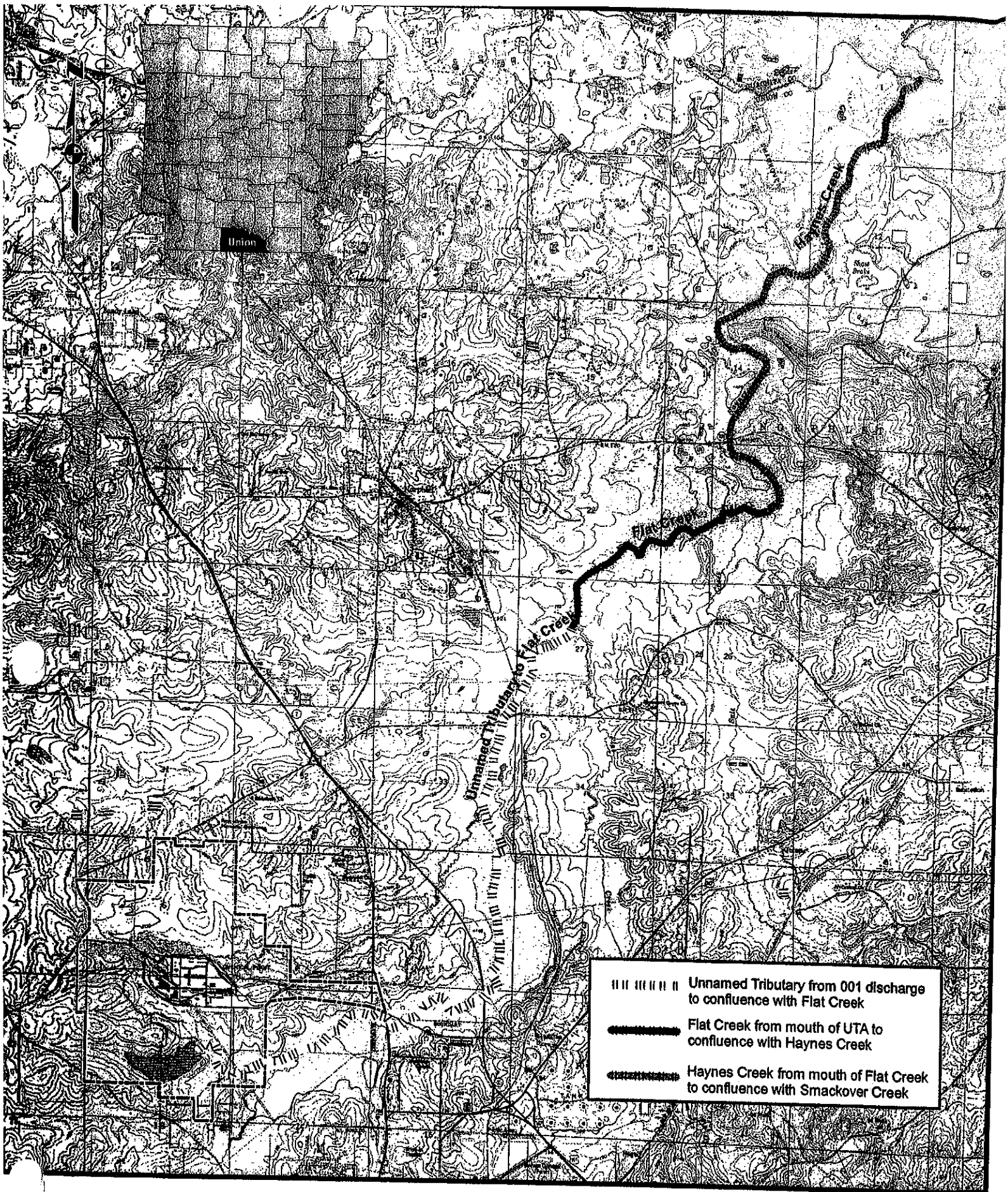
Pursuant to ADEQ policy, we are requesting a determination as to whether removal of the Designated Domestic Water Supply Uses from these waterbodies would conflict with the Arkansas Water Plan.

Thank you for your attention to this request for information. If you have any questions or need additional information please contact me or Roland McDaniel at (501) 847-7077.

Respectfully submitted,
GBM^c & ASSOCIATES

Vince Blubaugh
Principal

Attachment - Figure 1 – Map of Flat and Haynes Creeks



Proposed stream segments in the Haynes Creek watershed for removal of domestic water supply use via 3rd party rule making.

June 20, 2006

219 Brown Lane Bryant, AR 72022 (501) 847-7077 (501) 847-7943 fax

June 21, 2006

Mr. Robert Hart, P.E.
Chief Engineer
Arkansas Department of Health
4815 West Markham Street
Little Rock, AR 72205-3867

Re: Domestic Water Supply Determination
GBM[c] No. 2042-06-070

Dear Mr. Hart:

GBM[c] & Associates is developing documentation, pursuant to the Arkansas Water Quality Standards, to evaluate removal of the Designated Domestic Water Supply Uses from an unnamed tributary of Flat Creek, Flat Creek and Haynes Creek near El Dorado, Arkansas. Please see the attached map of the stream reaches.

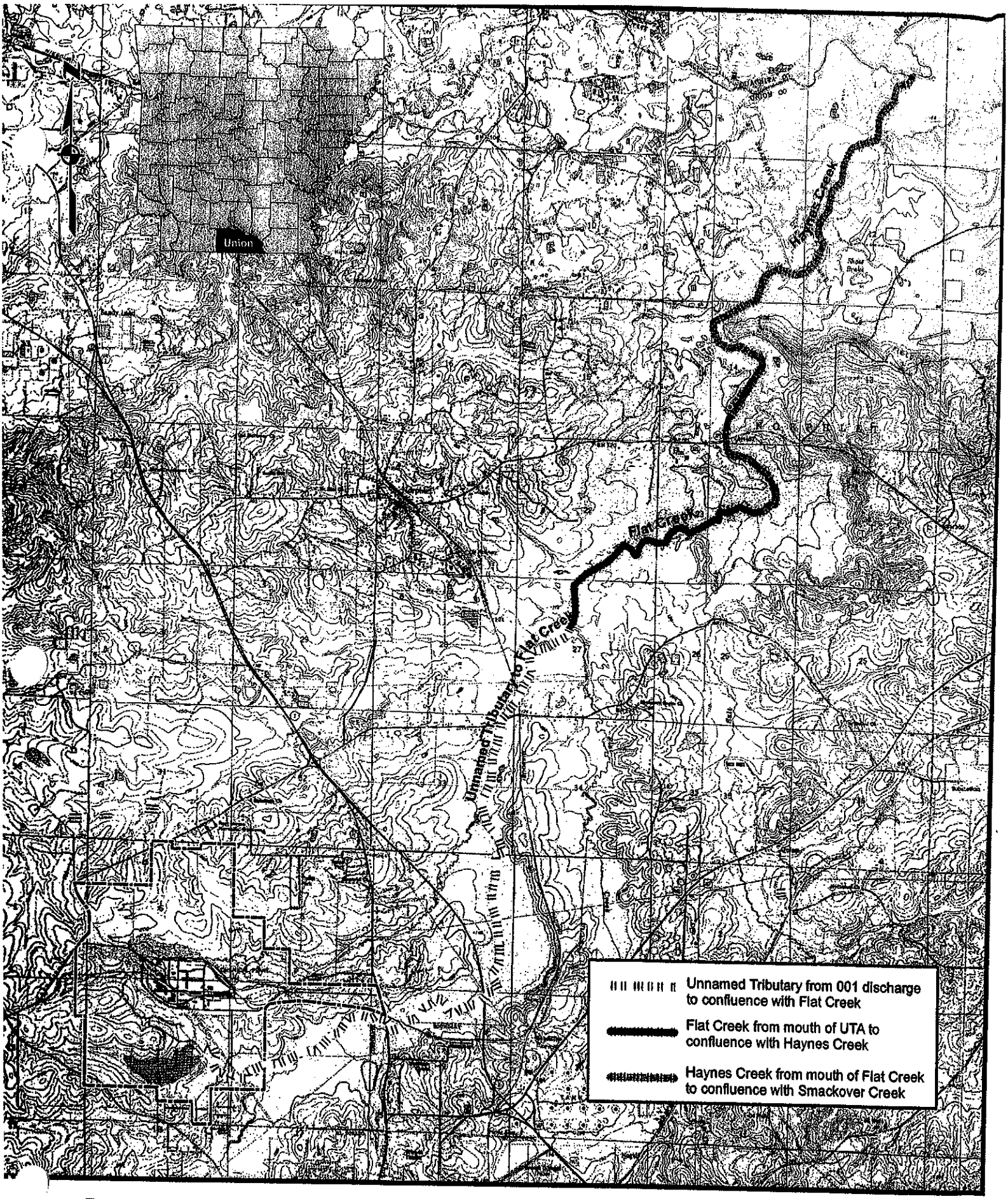
Pursuant to ADEQ policy, we are requesting a determination as to whether these have been approved, or are being considered for use, as domestic water supply sources.

Thank you for your attention to this request for information. If you have any questions or need additional information please contact me or Roland McDaniel at (501) 847-7077.

Respectfully submitted,
GBM[c] & ASSOCIATES

Vince Blubaugh
Principal

Attachment: Figure 1 – Map of Flat and Haynes Creeks



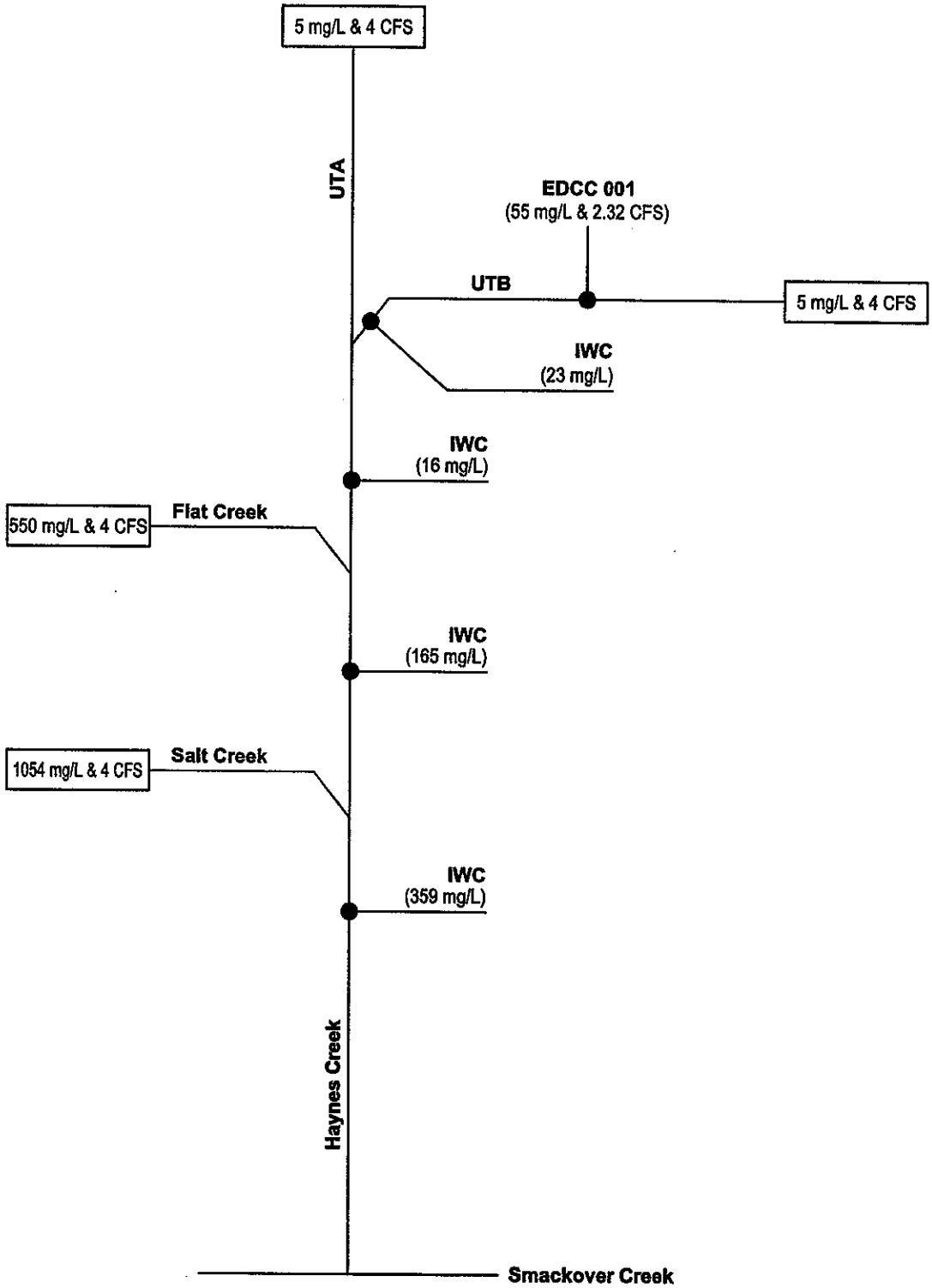
Proposed stream segments in the Haynes Creek watershed for removal of domestic water supply use via 3rd party rule making.

June 20, 2006

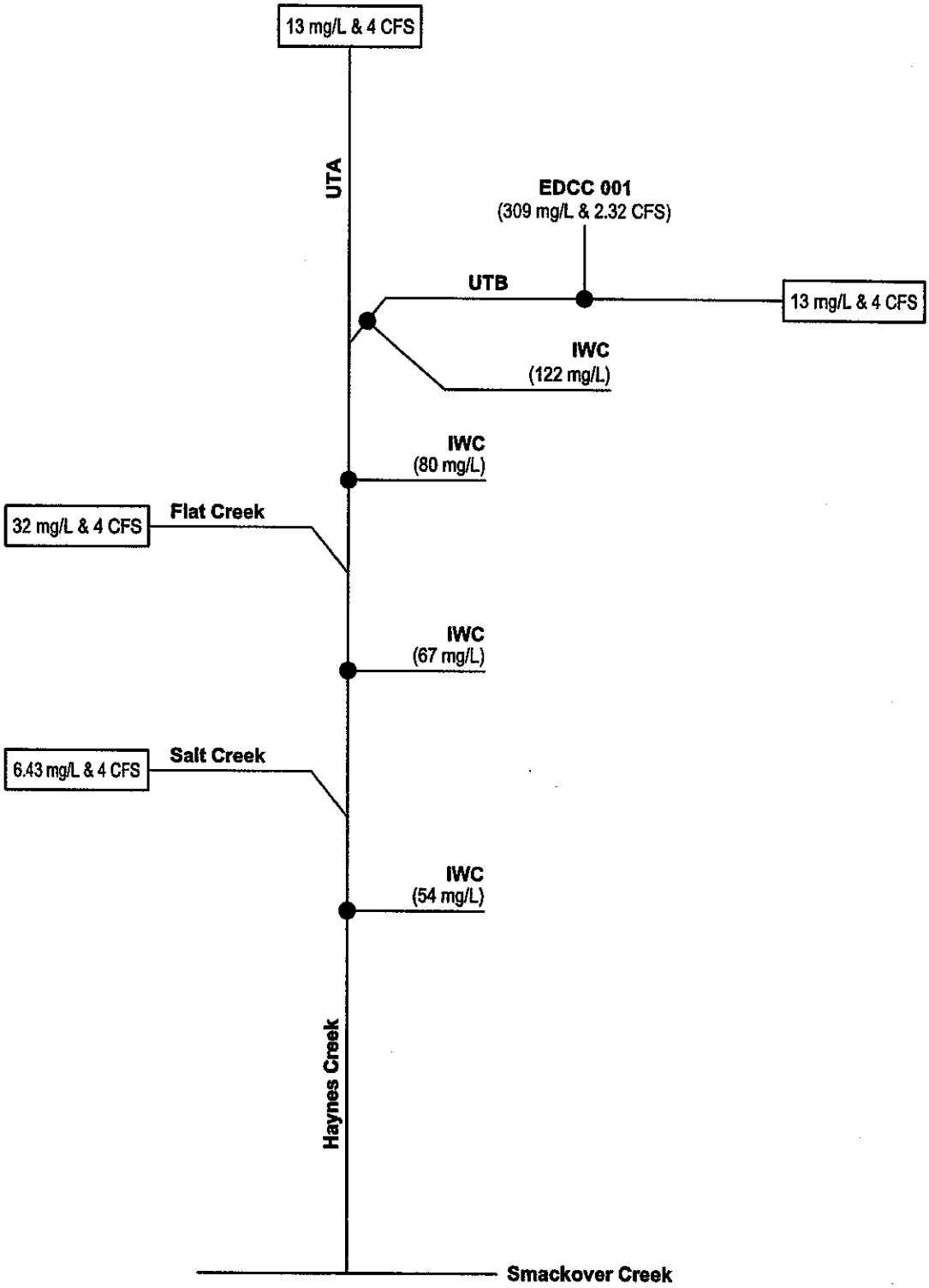
Appendix C

DMR and Outfall Specific Mineral Data with Statistical Assessment

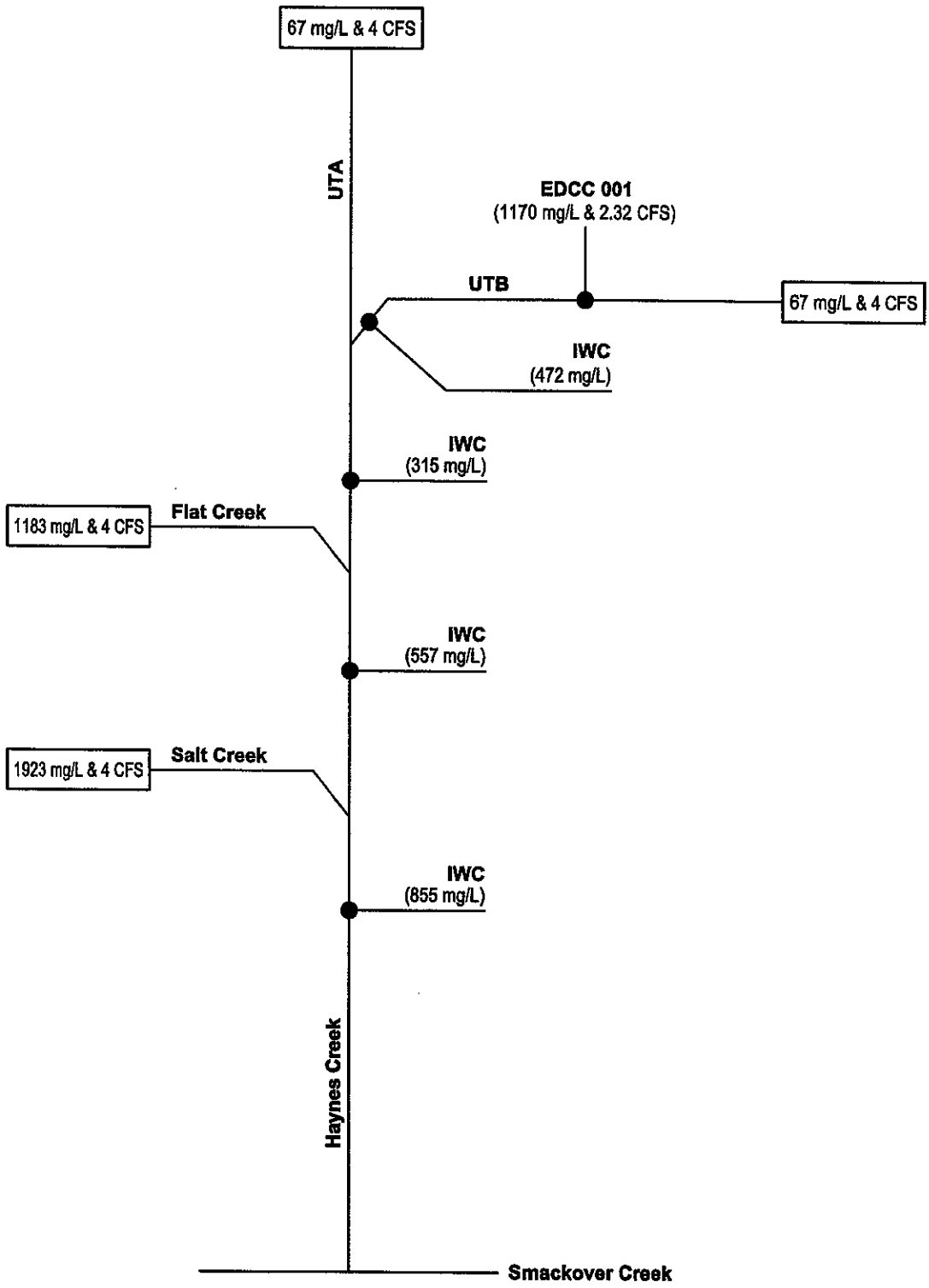
Chloride IWC Schematic



Sulfate IWC Schematic



TDS IWC Schematic



EDCC Outfall 001 DMR Flow Data 7/02 - 4/06

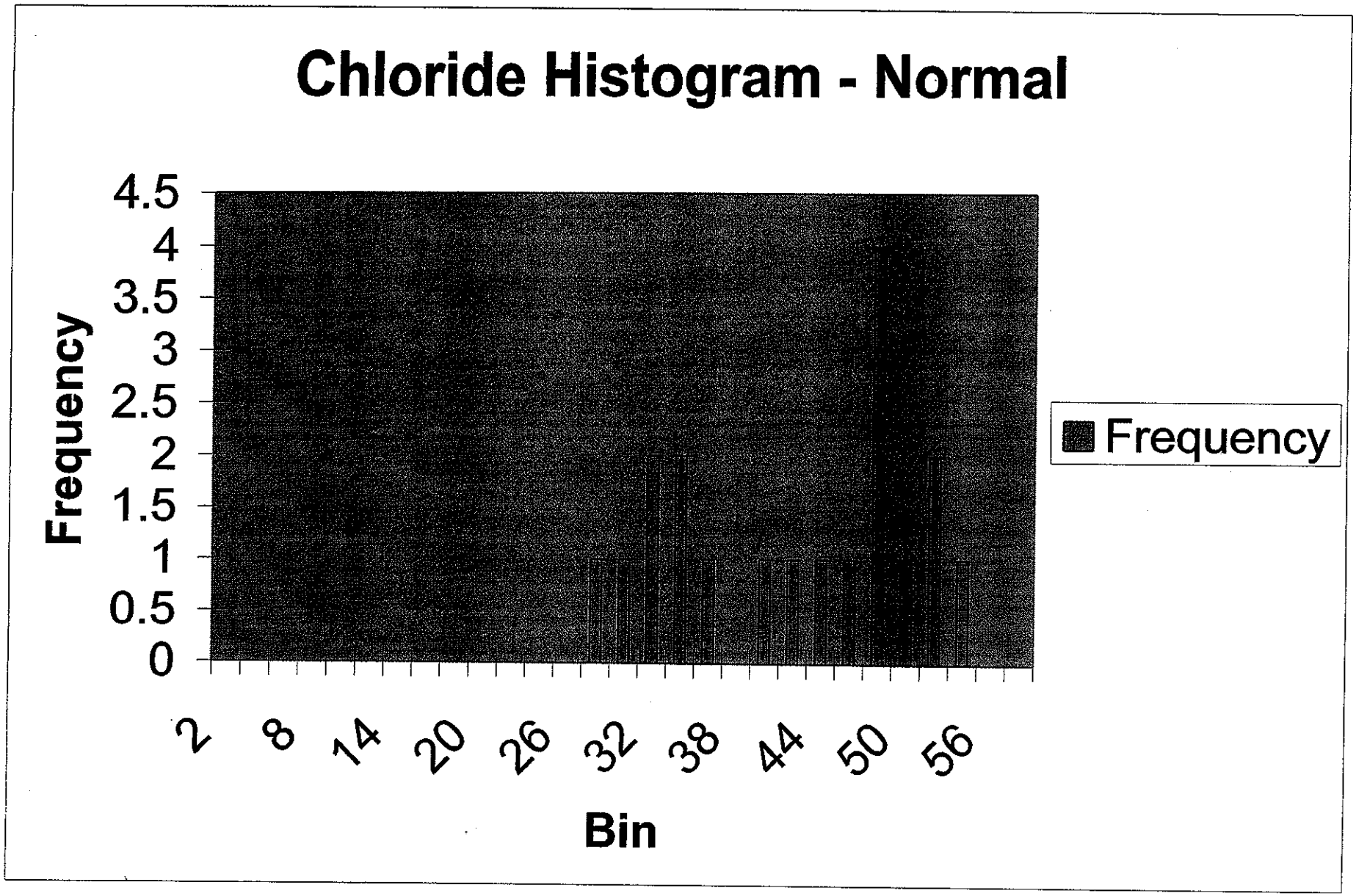
Flow (mgd) Mo Average	Date	Flow (cfs) Mo Average
0.0668	Jul-02	0.10
ND	Aug-02	ND
0.4967	Sep-02	0.77
ND	Oct-02	ND
0.5699	Nov-02	0.88
0.4562	Dec-02	0.71
0.6191	Jan-03	0.96
0.4015	Feb-03	0.62
1.0333	Mar-03	1.60
0.8786	Apr-03	1.36
0.449	May-03	0.69
0.4195	Jun-03	0.65
ND	Jul-03	ND
0.444	Aug-03	0.69
0.1927	Sep-03	0.30
0.1334	Oct-03	0.21
0.4225	Nov-03	0.65
ND	Dec-03	ND
0.3763	Jan-04	0.58
0.9064	Feb-04	1.40
0.8731	Mar-04	1.35
0.6358	Apr-04	0.98
0.7087	May-04	1.10
0.6252	Jun-04	0.97
0.5357	Jul-04	0.83
0.829	Aug-04	1.28
0.559	Sep-04	0.86
1.078	Oct-04	1.67
1.05	Nov-04	1.62
1.421	Dec-04	2.20
1.251	Jan-05	1.94
1.227	Feb-05	1.90
1.499	Mar-05	2.32
1.38	Apr-05	2.14
1.35	May-05	2.09
1.12	Jun-05	1.73
ND	Jul-05	ND
ND	Aug-05	ND
1.14	Sep-05	1.76
1.36	Oct-05	2.10
ND	Nov-05	ND
ND	Dec-05	ND
1.25	Jan-06	1.93
1.31	Feb-06	2.03
1.024	Mar-06	1.58
0.73	Apr-06	1.13
1.499	Maximum	2.319
0.811	Average	1.255
0.067	Minimum	0.103
38	Number	38

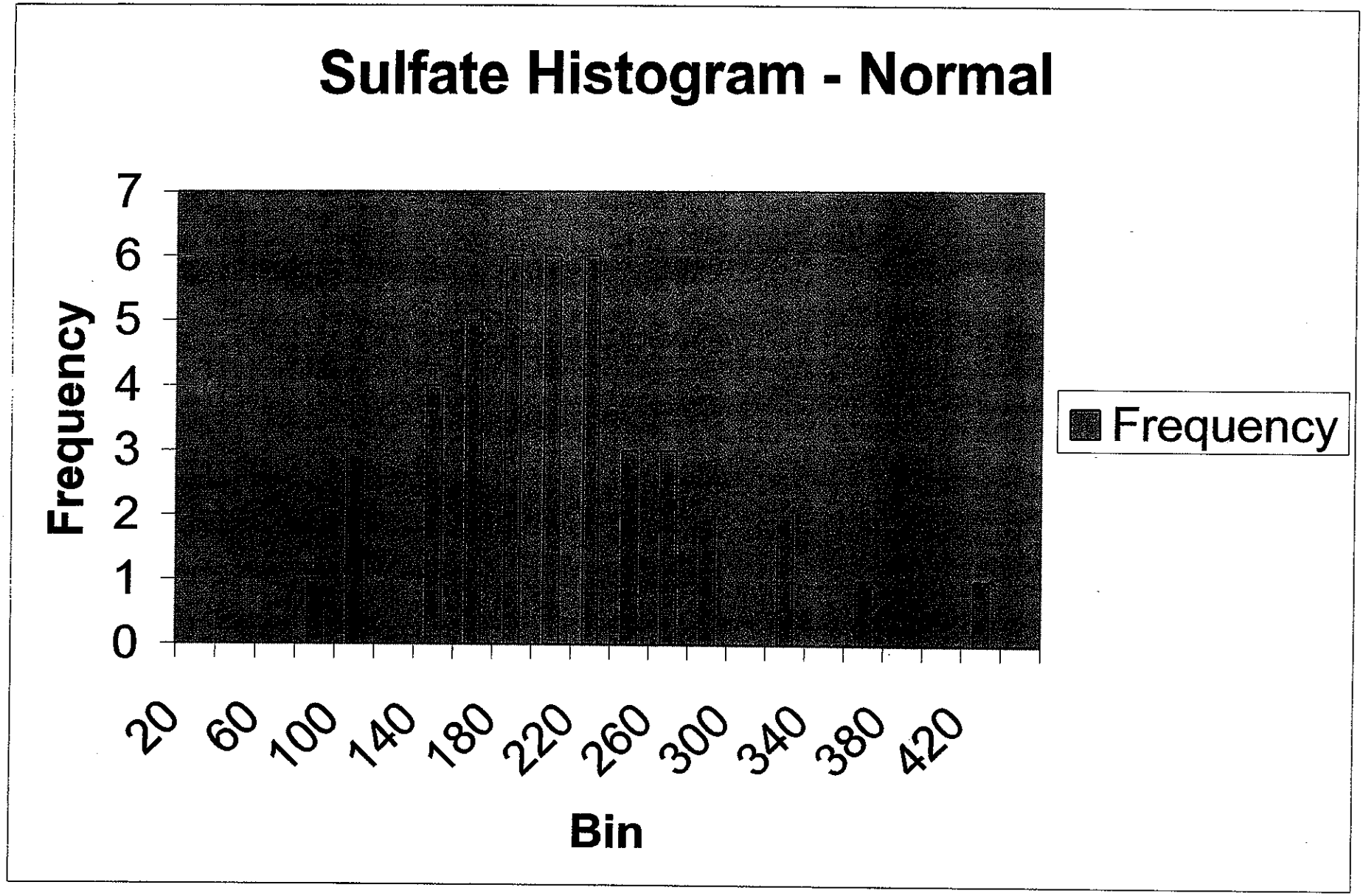
Summary of DMR monthly average values for Chloride, Sulfate, and TDS for EDCC Outfall 001.

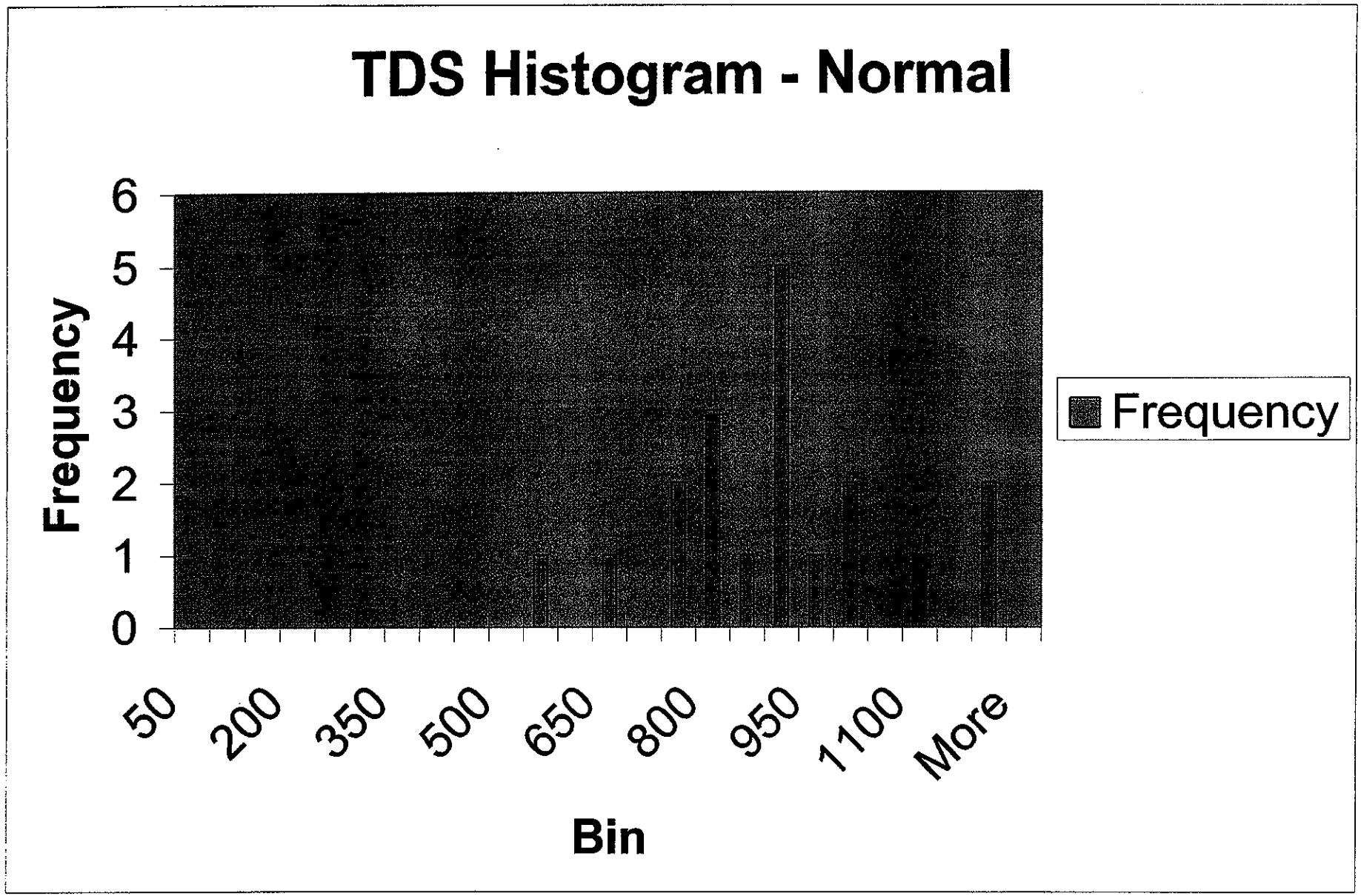
Date	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
Jan-02		136	
Feb-02		137	
Apr-02		232	
May-02		272	
Jun-02		408	
Jul-02		359	
Sep-02		309	
Nov-02		306	
Dec-02		213	
Jan-03		245	
Feb-03		213	
Mar-03		166	
Apr-03		160	
May-03		189	
Jun-03		252	
Aug-03		226	
Sep-03		213	
Oct-03		218	
Nov-03		219	
Jan-04		229	
Feb-04		184	
Mar-04		176	
Apr-04		158	
May-04		150	
Jun-04	40.2	134.5	900
Jul-04	34.4	125	710
Aug-04	48.4	178	940
Sep-04	51.6	200	1200
Oct-04	50.8	188	1000
Nov-04	44.2	179	1000
Dec-04	32.2	193	860
Jan-05	30.2	187	790
Feb-05	27	268	900
Mar-05	31.6	250	900
Apr-05	32.1	203	850
May-05	29.2	166	710
Jun-05	42.8	167	890
Sep-05	46.2	143	1200
Oct-05	47.6	160	1100
Jan-06	46.5	97	780
Feb-06	47.2	99.2	760
Mar-06	53.6	90.4	630
Apr-06	38.8	70.7	510

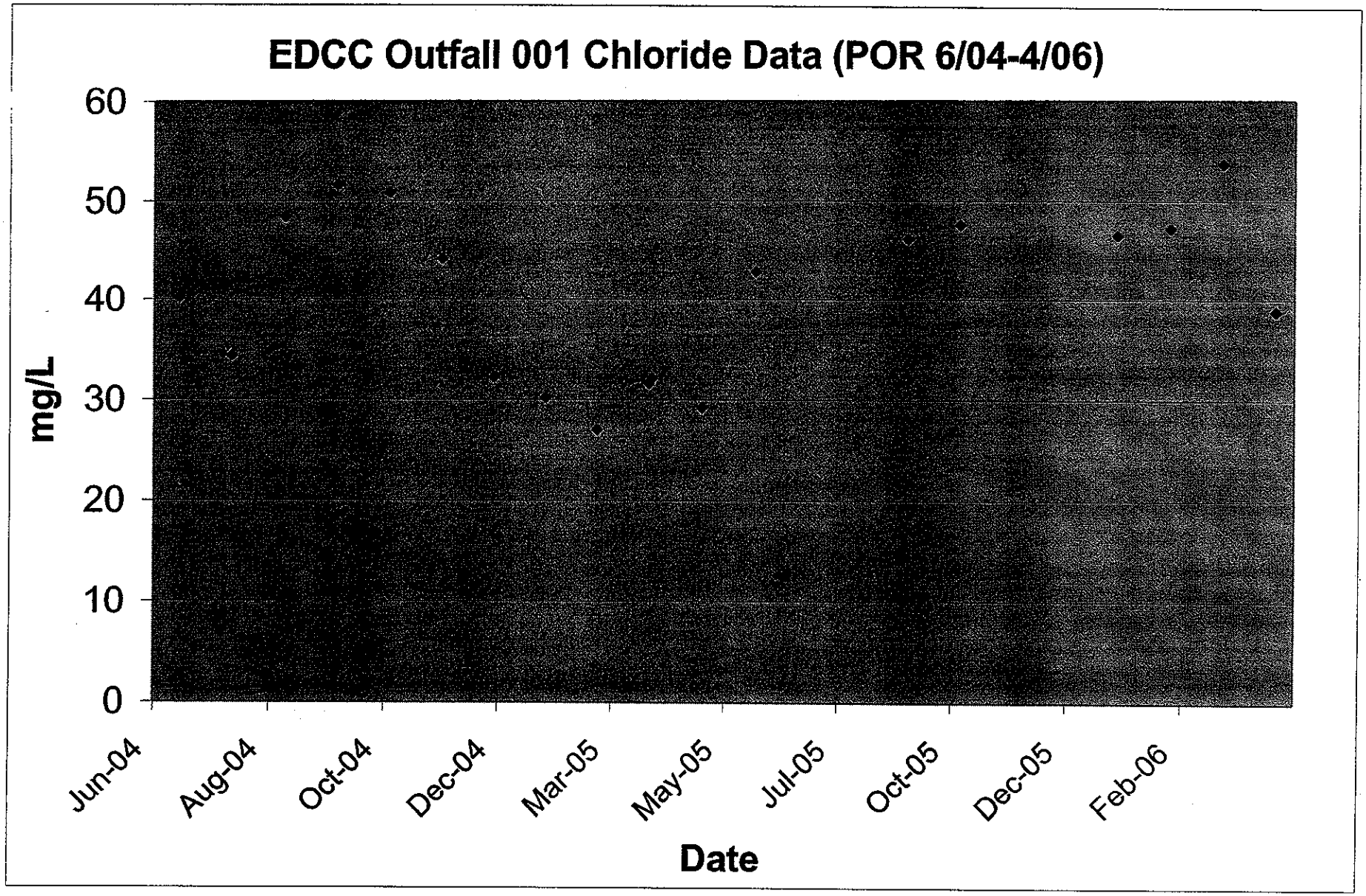
Summary of DMR monthly average values for Chloride, Sulfate, and TDS for EDCC Outfall 001.

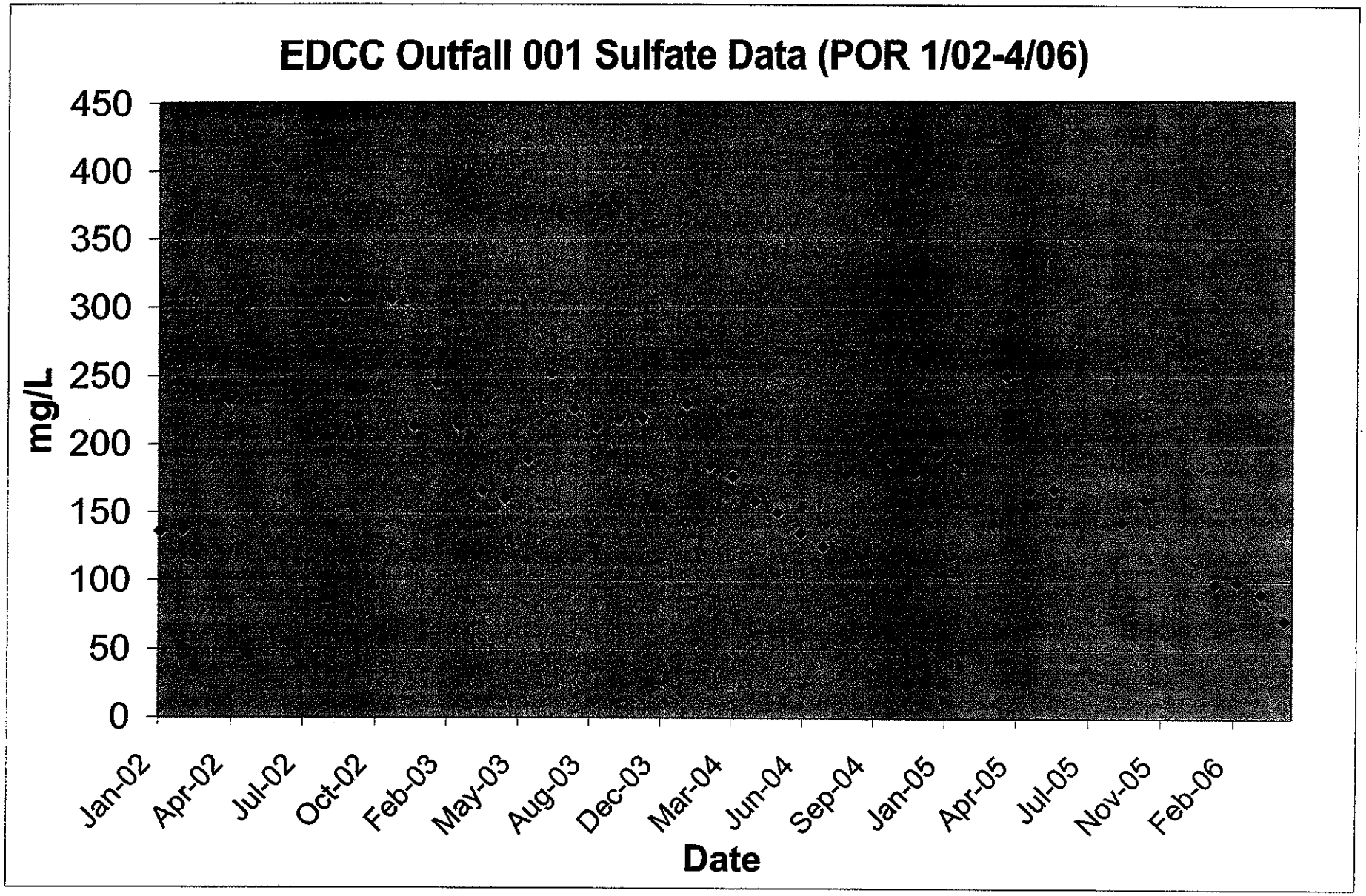
Statistics	Chlorides (mg/l)	Sulfate (mg/l)	TDS (mg/l)
Data Characterization			
count	19	43	19
standard deviation	9	68	179
CV	0.21	0.35	0.20
Pn	0.78	0.90	0.78
99%	0.99	0.99	0.99
95%	0.95	0.95	0.95
Z for 99 %tile	2.33	2.33	2.33
Z for 95 %tile	1.64	1.64	1.64
	Normal Formula	Normal Formula	Normal Formula


Chloride Histogram - Normal
Frequency
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2
8
14
20
26
32
38
44
50
56
Bin
Frequency


Sulfate Histogram - Normal
Frequency
7
6
5
4
3
2
1
0
20
60
100
140
180
220
260
300
340
380
420
Bin
Frequency


TDS Histogram - Normal
Frequency
0
1
2
3
4
5
6
50
200
350
500
650
800
950
1100
More
Bin
Frequency


EDCC Outfall 001 Chloride Data (POR 6/04-4/06)
60
50
40
30
20
10
0
mg/L
Jun-04
Aug-04
Oct-04
Dec-04
Mar-05
May-05
Jul-05
Oct-05
Dec-05
Feb-06
Date


EDCC Outfall 001 Sulfate Data (POR 1/02-4/06)
mg/L
450
400
350
300
250
200
150
100
50
0
Jan-02
Apr-02
Jul-02
Oct-02
Feb-03
May-03
Aug-03
Dec-03
Mar-04
Jun-04
Sep-04
Jan-05
Apr-05
Jul-05
Nov-05
Feb-06
Date

EDCC Outfall 001 - IWC Calcs - Final

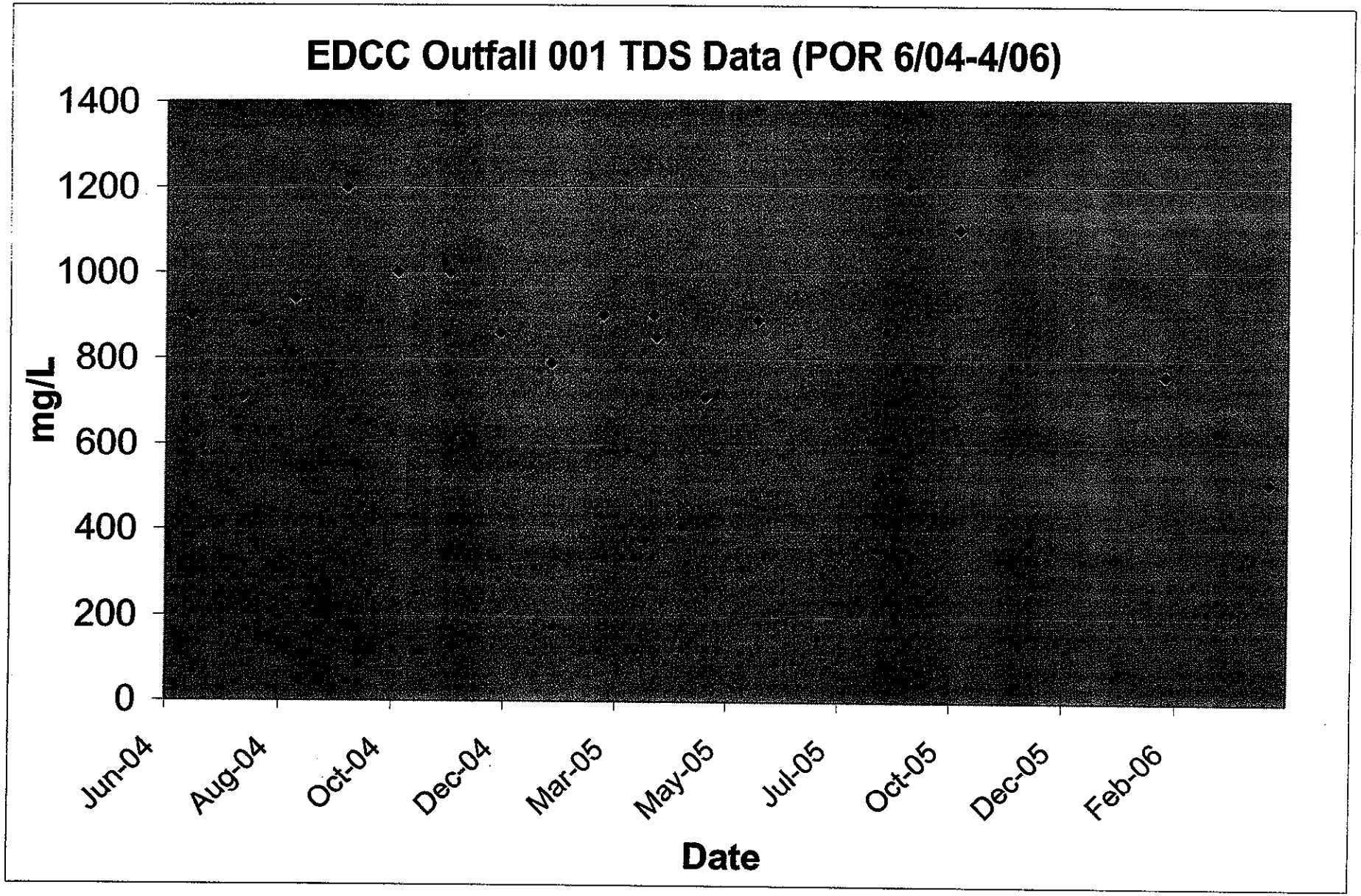
Chloride IWC	DISCHG CONC (mg/L)	DISCHG FLOW (cfs)	U/S CONC (mg/L)	U/S FLOW (cfs)	TOTAL FLOW (cfs)	IWC (mg/L)
UTB from EDCC Outfall 001 to confluence of Flat Creek	55	2.32	5	4	6.32	23
Flat Creek - from confluence of UTB to confluence of Flat Creek	23	6.32	5	4	10.32	16
Flat Creek - from confluence of Flat Creek to confluence with Salt Creek	16	10.32	550	4	14.32	165
Haynes Creek - from confluence of Flat & Salt Creeks to confluence with Shackover Creek	165	14.32	1054	4	18.32	359

Sulfate IWC	DISCHG CONC (mg/L)	DISCHG FLOW (cfs)	U/S CONC (mg/L)	U/S FLOW (cfs)	TOTAL FLOW (cfs)	IWC (mg/L)
UTB from EDCC Outfall 001 to confluence of Flat Creek	309	2.32	13	4	6.32	122
Flat Creek - from confluence of UTB to confluence of Flat Creek	122	6.32	13	4	10.32	80
Flat Creek - from confluence of Flat Creek to confluence with Salt Creek	80	10.32	32.0	4	14.32	67
Haynes Creek - from confluence of Flat & Salt Creeks to confluence with Shackover Creek	67	14.32	6.43	4	18.32	54

TDS IWC	DISCHG CONC (mg/L)	DISCHG FLOW (cfs)	U/S CONC (mg/L)	U/S FLOW (cfs)	TOTAL FLOW (cfs)	IWC (mg/L)
UTB from EDCC Outfall 001 to confluence of Flat Creek	1170	2.32	67	4	6.32	472
Flat Creek - from confluence of UTB to confluence of Flat Creek	472	6.32	67	4	10.32	315
Flat Creek - from confluence of Flat Creek to confluence with Salt Creek	315	10.32	1183	4	14.32	557
Haynes Creek - from confluence of Flat & Salt Creeks to confluence with Shackover Creek	557	14.32	1923	4	18.32	856

[1] U/S concentration is the average of data collected at FC-2 (4/17,20/06, 5/31/06) during the time of the aquatic life investigation.

[2] U/S concentration is the average of data in an ADEQ publication "TMDL Investigation of Water Quality Impairments to Unnamed Tributary to Flat Creek Union County, Arkansas", April 1998.


EDCC Outfall 001 TDS Data (POR 6/04-4/06)
1400
1200
1000
800
600
400
200
0
mg/L
Jun-04
Aug-04
Oct-04
Dec-04
Mar-05
May-05
Jul-05
Oct-05
Dec-05
Feb-06
Date

EDCC - Minerals IWC Calculations
Final

Highest monthly average flow used
95th Percentile Data used
Instream Background used

UTB Tributary (form Outfall 001 to confluence of UTA Tributary)

Chloride

((4 cfs * 5 mg/L) + (2.319 cfs * 55 mg/L)) / (4 cfs + 2.319 cfs)
20 128 6.319
148 6.319
23

Sulfate

((4 cfs * 13 mg/L) + (2.319 cfs * 309 mg/L)) / (4 cfs + 2.319 cfs)
52 717 6.319
769 6.319
122

TDS

((4 cfs * 67 mg/L) + (2.319 cfs * 1170 mg/L)) / (4 cfs + 2.319 cfs)
268 2713 6.319
2981 6.319
472

UTA Tributary (form confluence with UTB Tributary to confluence with Flat Creek)

Chloride

((4 cfs * 5 mg/L) + (6.319 cfs * 23 mg/L)) / (4 cfs + 6.3191.16 cfs)
20 145 10.319
165 10.319
16

Sulfate

((4 cfs * 13 mg/L) + (6.319 cfs * 122 mg/L)) / (4 cfs + 6.3191.16 cfs)
52 771 10.319
823 10.319
80

TDS

((4 cfs * 67mg/L) + (6.319 cfs * 472 mg/L)) / (4 cfs + 6.3191.16 cfs)
268 2983 10.319
3251 10.319
315

Flat Creek (from confluence with UTA Tributary to confluence with Salt Creek)

Chloride

((4 cfs * 550 mg/L) + (10.319 cfs * 16 mg/L)) / (4 cfs + 10.319 cfs)
2200 165 14.319
2365 14.319
165

Sulfate

((4 cfs * 32 mg/L) + (10.319 cfs * 80 mg/L)) / (4 cfs + 10.319 cfs)
128 826 14.319
954 14.319
67

TDS

((4 cfs * 1183 mg/L) + (10.319 cfs * 315 mg/L)) / (4 cfs + 10.319 cfs)
4732 3250 14.319
7982 14.319
557

Haynes Creek (from confluence of Flat & Salt Creeks to confluence with Smackover Creek)

Chloride

((4 cfs * 1054 mg/L) + (14.319cfs * 165 mg/L)) / (4 cfs + 14.319 cfs)
4216 2363 18.319
6579 18.319
359

Sulfate

((4 cfs * 6.43 mg/L) + (14.319 cfs * 67 mg/L)) / (4 cfs + 14.319 cfs)
25.72 959 18.319
985 18.319
54

TDS

((4 cfs * 1923 mg/L) + (14.319 cfs * 557 mgL)) / (4 cfs + 14.319 cfs)
7692 7976 18.319
15668 18.319
855

IWC = [(Qb x Cb) + (Qe x Ce)] / (Qb + Qe)

Where:

Qb = The background flow of the receiving stream
Cb = The background concentration of chloride, sulfate, or TDS in the receiving stream
Qe = The discharge flow of the effluent
Ce = The effluent concentration of chloride, sulfate or TDS

Appendix D
Summary of Toxicity Testing Data

El Dorado Chemical Company - Critical Dilution = 100%
Biomonitoring - No Observed Effect Concentrations for Survival

Date	Outfall 001	
	Water Flea	***Fathead Minnow***
Mar-01	0%	0%
Jun-01	25%	25%
Sep-01	25%	25%
Mar-02	12%	12%
Jun-02	25%	12%
Sep-02	12%	6%
Dec-02	12%	12%
Mar-03	25%	25%
Jun-03	12%	6%
Sep-03	50%	25%
Dec-03	50%	12%
Mar-04	25%	12%
Jun-04	56%	32%
Jul-04	56%	32%
Aug-04	75%	42%
Sep-04	100%	75%
Oct-04	100%	0%
Nov-04	100%	42%
Dec-04	100%	56%
Jan-05	100%	32%
Feb-05	100%	32%
Mar-05	100%	56%
Apr-05	100%	100%
May-05	100%	100%
Jun-05	100%	100%
Jul-05		
Aug-05		
Sep-05	100%	100%
Oct-05	100%	100%
Jan-06	100%	100%
Feb-06	100%	100%
Mar-06	100%	100%
Apr-06	100%	100%

Appendix E
Field Data Sheets

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: FC-1		**LOCATION:**	
STREAM NAME:		**RIVER BASIN:**	
LAT:	**LONG:**	**PROJECT:**	
INVESTIGATORS: SKH/JBB	**DATE/TIME:** 4/19/06 1130	**FORM CHECKED BY:**	

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
20% ☒	% cloud cover	☐ ____%
☐	clear/sunny	☒

Heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 80 °C/°F

Other _____

STREAM ATTRIBUTES

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☐ Other _____

Catchment Area: _____ mi^2

Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured? ☒ Yes ☐ No

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest 15 %
☒ Pasture 15 %
☐ Row Crops ____%
☐ Urban ____%
☒ Sub-Urban 30
☐ Commercial ____%
☒ Industrial 40 %
☐ Other _____ %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☒ Industrial Storm Water
☒ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☒ Mature Forest 30 % ☒ Shrub/Sapling 60 % ☒ Herbs/Grasses 10 % ☐ Turf ____%

STREAM MORPHOLOGY

☒ Riffle 10 % ☒ Run 40 % ☒ Pool 50 %

STREAM DISTURBANCES

☒ Roads ☒ Bridges ☐ Pipelines ☐ Beaver Dams ☐ Point Source
☐ Dams ☒ Trash ☒ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other _____

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☐ Degrading ☒ Widening ☐ Headcutting

WATER OBSERVATIONS

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☒ Sheen ☐ Globs
☐ Flecks ☐ None ☐ Other _____

Turbidity/Water Clarity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT OBSERVATIONS

Sediment Odor
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☐ Other _____

Stream Habitat Assessment (Semi-Quantitative)

Station #: EC-1	Stream: Flat Creek	Date/Time: 4/19/06 / 0940-	Initials: SKH/OBB
u/s latitude:	d/s latitude:	u/s:	
u/s longitude:	d/s longitude:	d/s:	

1. Reach Length Determination

Parameter	Measurement Number / Morph Regime					Average	Total Reach Length (ft)	Sub-Reach Length[2] (ft)
	1	2	3	4	5			
Bankfull Width	25'	24'	23.5	25.0'	82'	25.9	518'	51.8
Bankfull Depth	1.3	1.7	—	—	—	1.5	na	na

[1]Average width times 20 [2]Total Length divided by 10

2. Riffle-Pool Sequence

Morph Type	Reach Number - Length in Feet										
	1	2	3	4	5	6	7	8	9	10	Total
Riffle	X	11.8	28.0	18.0	51.8	22.0	10	X	X	X	141.6
Run	21.8	40	23.8	33.8	X	29.8	29	X	X	15	193.2
Pool	30.0	X	X	X	X	X	12.8	51.8	51.8	36.8	183.2
Sequence[1]	~~~	----	xxx	xxxxx	----	xxx	xxxxxxx	----	~~~	~~~	n/a

[1]Riffle="xxx", Run="----", Pool="~~~"

27%
37%
35%

Under Bridge Influence

3. Depth and Width Regime

Morph Type	Reach No. - Average Depth (ft) / Width (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth[3]	X	0.6/0.2	0.6/0.2	0.6/0.2	0.4/0.2	0.4/0.2	0.5/0.3	X	X	X	.52/.22
Riffle Width	X	21.2	21.2	11.0	15'	15.0	10	X	X	X	15.6
Run Depth[3]	1.0/0.8	1.0/0.8	0.2/0.2	0.2/0.2	X	1.0/0.6	1.0/0.6	X	X	1.6/0.8	.86/.57
Run Width	12.2	14'	12.0	12.0	X	9.0	9.0	X	X	10'	11.2
Pool Depth[3]	2.9/1.8	1.0/0.8	X	X	X	X	1.3/0.8	2.4/1.4	4.0/2.3	3.0/1.5	2.6/1.6
Pool Width	29.7	X	X	X	X	X	12.0	20.0	21.6	21.0	20.7

[3]Thalwag / Average

Shallow Run — Long Sandy Riffle

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	30	20	30	20	30	30	50	50	50	60	37%

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. - Availability and Quality of Fish Habitat										
	1	2	3	4	5	6	7	8	9	10	Average
% Area	40	35	30	20	30	30	30	60	70	60	39.5%

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. - Dominant Substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle	X	2	2	2	2	2	2	X	X	X	2
Run	2	2	2	2	X	2	2	X	X	2	2
Pool	2	X	X	X	X	X	2	2	2	2	2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders-Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	40	30	20	10	10	20	30	40	60	40	30

Stream Habitat Assessment (Semi-Quantitative)

Station #: FC-1	Date/Time: 4/19/04	Initials:

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Morph Type		Reach No – Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes	X	0	0	0	0	0	0	X	X	X	0
	Periphyton	X	0	0	0	0	0	0	X	X	X	0
Run	Macrophytes	0	0	0	10	X	0	0	X	X	0	0
	Periphyton	0	0	0	0	X	0	0	X	X	0	0
Pool	Macrophytes	0	X	X	X	X	X	0	0	0	0	0
	Periphyton	0	X	X	X	X	X	0	0	0	0	0

10. Canopy Cover (Percent Stream Shading)

Section	Reach No – Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	80	80	20	10	70	60	60	60	30	50	52

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7	8	6	7	6	6	6	7	8	8	6.9
Slope (°)	45	55	65	45	60	75	90	70	80	70	65.5
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7	5	6	7	5	6	8	6	5	7	6.2
Slope (°)	70	90	50	50	80	80	65	35	60	60	≈6.0

Score 9-10 = Stable, < 5% bank affected. Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding. Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	60	40	50	30	20	35	40	40	40	50	40.5
RB Section	1	2	3	4	5	6	7	8	9	10	Average
%	50	40	50	30	60	45	40	40	20	30	40.5

13. Riparian Vegetative Zone Width

Pasture

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	10/m	10/m	2/ss,g	1/g	5/p	5/p	5/p	5/p	5/p	5/p	5.3
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	9/ss	9/ss	2/ss/g	1/g	3/p	1/p	1/p	1/p	1/p	1/p	2.9

Score 9-10 = Riparian Zone > 18 meters Score 6-8 = Riparian Zone 18 - 12 meters Note cover type: m=mature forest,
Score 3-5 = Riparian Zone 11 - 6 meters Score 1-2 = Riparian Zone < 6 meters ss=shrub/sapling, g=native grass, p=pasture

Bridge

Big Trees

14. Land-Use Stream Impacts

Section	Reach No – Impact Score										Average
	1	2	3	4	5	6	7	8	9	10	
Impact	C,I,O 2	C,I,O 2	C,I,O 2	C,I 2	1	1	1	1	1	1	1.2

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other Bridge
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: FC-1	Client:
Stream name:	Date/Time: 4/19/06
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: FC-1	Date/Time: 4/19/06
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 7 LB	Left Bank 10 9	8 (7) 6	5 4 3	2 1
SCORE 6 RB	Right Bank 10 9	8 7 (6)	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 2 LB	Left Bank 10 9	8 7 6	5 4 3	(2) 1
SCORE 2 RB	Right Bank 10 9	8 7 6	5 4 3	(2) 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 5 LB	Left Bank 10 9	8 7 6	(5) 4 3	2 1
SCORE 3 RB	Right Bank 10 9	8 7 6	5 4 (3)	2 1

TOTAL SCORE: 102
AVERAGE SCORE: 10.2

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: FC-2	**LOCATION:** u/s of Bear Road
STREAM NAME: Flat Creek	**RIVER BASIN:** Ouachita River
LAT: **LONG:**	**PROJECT:** EDCC-46
INVESTIGATORS: SKH/ASN/JOP/TOM	**DATE/TIME:** 4/17/06 **FORM CHECKED BY:**

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 85 °C/°F

Other _____

STREAM CHARACTERISTICS

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☐ Other _____

Catchment Area: _____ mi²

Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured? ☒ Yes ☐ No

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest 70 % ☒ Sub-Urban 20
☐ Pasture ____% ☐ Commercial ____%
☐ Row Crops ____% ☐ Industrial ____%
☒ Urban 10 % ☐ Other _____ % mostly

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☒ Industrial Storm Water 1.Mk
☒ Urban/Sub-Urban Storm Water 1.Mk

RIPARIAN VEGETATION

☒ Mature Forest 80 % ☒ Shrub/Sapling 20 % ☐ Herbs/Grasses ____% ☐ Turf ____%

STREAM MORPHOLOGY

☐ Riffle _____% ☒ Run 46 % ☒ Pool 54 %

STREAM DISTURBANCES

☒ Roads ☒ Bridges ☐ Pipelines ☐ Beaver Dams ☐ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other _____
Very 1.Mk stream disturbance

Channelized: ☐ Yes ☐ Some ☒ No

Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy

Channel Dynamics: ☐ Aggrading ☐ Degrading ☒ Widening ☐ Headcutting very channelized

WATER QUALITY EVALUATIONS

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☒ None ☐ Other _____

Turbidity/Water Clarity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☒ Opaque ☐ Stained ☐ Other _____

SEDIMENT EVALUATIONS

Sediment Odor
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☒ Other Silts

Stream Habitat Assessment (Semi-Quantitative)

Station #: EC-2	Stream: Flat Creek	Date/Time: 4/17/06 1000-1145	Initials: SKH/JJF
u/s latitude:	d/s latitude:	u/s:	
u/s longitude:	d/s longitude:	d/s:	

1. Reach Length Determination

Parameter	Measurement Number / Morph Regime 1						Average	Total Reach Length (ft)	Sub-Reach Length (ft)
	1	2	3	4	5	6			
Bankfull Width	20.0	24.0	15.5	22.0'	24.5'		21.2	424	42.4
Bankfull Depth	2.1 / 0.5	— 4.3	2.5 / 1.0	— / 2.1	1.9 / 1.1		2.23	na	na

[1] Average width times 20 [2] Total Length divided by 10

2. Riffle-Pool Sequence

Morph Type	Reach Number / Length in Feet										
	1	2	3	4	5	6	7	8	9	10	Total
Riffle	X	X	X	X	X	X	X	X	X	X	—
Run	42.4	16.4	21.2	42.4	42.4	30	X	X	X	X	46
Pool	X	26.0	21.2	X	X	12.4	42.4	42.4	42.4	42.4	54
Sequence[1]	----	~~~	~~~	----	----	---~~~	~~~	~~~	~~~	~~~	n/a

[1] Riffle="xxx", Run="---", Pool="~~~"

3. Depth and Width Regime

Morph Type	Reach No. / Average Depth (ft) / Width (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth[3]	/	/	/	/	/	/	/	/	/	/	—
Riffle Width	X	X	X	X	X	X	X	X	X	X	—
Run Depth[3]	1.5/0.9	1.2/0.8	1.5/1.0	1.5/1.0	2.6/1.5	1.0/0.5	/	/	/	/	1.55/0.95
Run Width	13.5	10	10	14	15	14	X	X	X	X	12.8
Pool Depth[3]	/	3.3/2.5	3.8/3.0	/	/	3.4/2.0	2.7/1.8	2.5/1.5	2.6/1.6	2.6/1.8	3.27/2.13
Pool Width	X	12	16	X	X	12	14	23	23	15	16.4

[3] Thalwag / Average

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	45	20	30	20	30	30	30	50	60	50	36.5

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. / Availability and Quality of Fish Habitat										
	1	2	3	4	5	6	7	8	9	10	Average
% Area	60	20	45	30	30	40	40	60	70	70	46.5

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. / Dominant Substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle	X	X	X	X	X	X	X	X	X	X	—
Run	2	1	2	2	2	2	X	X	X	X	1.8
Pool	X	1	1	X	X	2	1	1	1	2	1.3

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	50	13	30	40	30	40	30	40	30	60	36.5

Stream Habitat Assessment (Semi-Quantitative)

Station #: FC-2	Date/Time: 4/17/06 1000 - 1145	Initials: SKH

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Habitat Type		Reach No. - Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes	X	X	X	X	X	X	X	X	X	X	—
	Periphyton											—
Run	Macrophytes	0	0	0	0	0	0	X	X	X	X	0
	Periphyton	0	0	0	0	0	0					0
Pool	Macrophytes	X	0	0	X	X	0	0	0	0	0	0
	Periphyton		0	0			0	0	0	0	0	0

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. - Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	80	80	80	90	70	60	90	90	70	80	74

11. Bank Stability (Score) and Slope (Degrees)

RA Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	5	7	3	6	7	7	7	8	7	7	6.4
Slope (°)	75	90	80	70	85	75	80	80	80	90	80.5
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average Score**
Score	7	5	6	6	6	7	7	7	7	7	6.5
Slope (°)	85	90	90	90	80	80	80	70	80	80	82.5

Score 9-10 = Stable, < 5% bank affected.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	70	90	30	60	70	50	60	60	50	70	61
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
%	70	50	50	70	70	70	60	60	60	50	60

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	10	10	10	10	10	10	10	10	10	10	10
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average Score**
Score	10	10	10	10	10	10	10	10	10	10	10

Score 9-10 = Riparian Zone > 18 meters
Score 6-8 = Riparian Zone 18 - 12 meters
Note cover type: m=mature forest, ss=shrub/sapling, g=native grass, p=pasture
Score 3-5 = Riparian Zone 11 - 6 meters
Score 1-2 = Riparian Zone < 6 meters

14. Land-Use Stream Impacts

Section	Reach No. - Impact Score										
	1	2	3	4	5	6	7	8	9	10	Average
Impact	0	1	1	1	1	1	1	1	1	1	0.1

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other ROAD
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: FC-2	Client: EDC
Stream name: Flat Creek	Date/Time: 4/17/2012
Location:	Form Completed By: SK/DDP

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 18	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: FC-2	Date/Time: 4/17/06
Stream name: Flat Creek	Form Completed By: SKH/JOP

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity SCORE 14	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line. 20 19 18 17 16	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line. 15 (14) 13 12 11	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. 10 9 8 7 6	Channel straight; waterway has been channelized for a distance. 5 4 3 2 1
7. Channel Flow Status SCORE 17	Water reaches base of both lower banks and minimal amount of channel substrate is exposed. 20 19 18 (17) 16	Water fills >75% of the available channel; or < 25% of channel substrate is exposed. 15 14 13 12 11	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed. 10 9 8 7 6	Very little water in channel and mostly present as standing pools. 5 4 3 2 1
8. Bank Stability SCORE 6 LB SCORE 7 RB	Banks stable; no evidence of erosion or bank failure. <5% affected. Left Bank 10 9 Right Bank 10 9	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected. 8 7 (6) 8 (7) 6	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods. 5 4 3 5 4 3	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars. 2 1 2 1
9. Vegetative Protection SCORE 4 LB SCORE 4 RB	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally. Left Bank 10 9 Right Bank 10 9	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally. 8 7 6 8 7 6	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. 5 (4) 3 5 (4) 3	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height. 2 1 2 1
10. Riparian Vegetative Zone Width SCORE 10 LB SCORE 10 RB	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone. Left Bank 10 9 Right Bank 10 9	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. 8 7 6 8 7 6	Width of riparian zone 6-12 meters; human activities have impacted a great deal. 5 4 3 5 4 3	Width of riparian zone <6 meters; little riparian vegetation to human activities. 2 1 2 1

TOTAL SCORE: 142
AVERAGE SCORE: 14.2

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: UTA-1	**LOCATION:** Bethany 178th St. & Bridge
STREAM NAME: Unnamed Trib to Flat Creek	**RIVER BASIN:** Quachita River
LAT: **LONG:**	**PROJECT:** EDC-4C
INVESTIGATORS: SKG/REM/TOT/JRD	**DATE/TIME:** 4/18/00 1535 **FORM CHECKED BY:**

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☐ Yes ☐ No

Air Temperature 95 °C/°F

Other _____

STREAM ATTRIBUTES

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☐ Other _____

Catchment Area: _____ mi^2

Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☐ Low ☒ None

Flows Measured? ☐ Yes ☒ No – ND

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest 30 %
☐ Pasture ____ %
☐ Row Crops ____ %
☒ Urban 10 %
☒ Sub-Urban 50 %
☐ Commercial ____ %
☒ Industrial 10 %
☐ Other _____ %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☒ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☐ Mature Forest ____ % ☒ Shrub/Sapling 90 % ☒ Herbs/Grasses 10 % ☐ Turf ____ %

STREAM MORPHOLOGY

☐ Riffle _____ % ☐ Run _____ % ☒ Pool 100 %

STREAM DISTURBANCES

☒ Roads ☒ Bridges ☐ Pipelines ☐ Beaver Dams ☐ Point Source
☐ Dams ☒ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other _____

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☒ Aggrading ☐ Degrading ☐ Widening ☐ Headcutting

WATER OBSERVATIONS

Water Odors
☐ Normal/None ☐ Sewage
☒ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☒ Sheen ☐ Globs
☐ Flecks ☐ None ☐ Other _____

Turbidity/Water Clarity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☒ Stained ☐ Other _____

SEDIMENT OBSERVATIONS

Sediment Odor
☐ Normal ☐ Sewage ☒ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☒ Other Silt/Clay

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTA-1	Stream: unnamed Trib to Flat Ck	Date/Time: 4/18/06 1430-1520	Initials: BH/JOF
u/s latitude:	d/s latitude:	u/s:	
u/s longitude:	d/s longitude:	d/s:	

NOTE: H2O TO Deep to wade in most Places Most measurements are estimates

1. Reach Length Determination

Parameter	Measurement Number / Morph Regime 1	2	3	4	5	Average	Total Reach Length[1] (ft)	Sub-Reach Length[2] (ft)
Bankfull Width	18	19.0	21.0	22	20	20	400	40
Bankfull Depth							na	na

[1] Average width times 20 [2] Total Length divided by 10

2. Riffle-Pool Sequence

Border Influence

Morph Type	Reach Number - Length in Feet 1	2	3	4	5	6	7	8	9	10	Total
Riffle											
Run											
Pool	40'										
Sequence[1]											n/a

[1] Riffle="xxx", Run="—", Pool="~~"

3. Depth and Width Regime

Morph Type	Reach No. - Average Depth (ft) / Width (ft) 1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth[3]											
Riffle Width											
Run Depth[3]											
Run Width											
Pool Depth[3]	4'/2.3	7.4/3.3	7.4/2.2	7.4/2.5	7.4/2.5	3.8/2.0	2.8/1.5	4.2/2.7	3.8/2.0	3.0/2.0	3.8/2.3
Pool Width	20'	25'	18	20	20	16	27	20	16	30	20.1

[3] Thalwag / Average

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	60	40	50	60	60	40	30	40	40	20	46

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. - Availability and Quality of Fish Habitat 1	2	3	4	5	6	7	8	9	10	Average
% Area	80	60	70	70	70	50	40	50	50	30	57

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. - Dominant substrate 1	2	3	4	5	6	7	8	9	10	Average
Riffle											
Run											
Pool	1	1	1	1	1	1	1	1	1	1	1

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	11	12	Average
% Embedded													

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	40	40	60	40	70	40	40	50	60	80	52

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTA-1	Date/Time:	Initials:

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Morph Type		Reach No. - Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes											
	Periphyton											
Run	Macrophytes											
	Periphyton											
Pool	Macrophytes	0	0	0	0	0	0	0	0	0	0	0
	Periphyton	0	0	5	5	5	5	5	5	5	20	5.5

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. - Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	30	40	40	60	50	30	10	65	50	10	38.5

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7	7	8	8	7	8	8	8	7	6	7.4
Slope (°)	80	70	80	80	80	70	40	60	90	50	70
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7	8	8	7	5	6	6	7	8	6	6.8
Slope (°)	70	65	70	65	90	90	40	50	80	45	66.5

Score 9-10 = Stable, < 5% bank affected.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	65	60	65	65	55	50	40	60	70	60	59
RB Section	1	2	3	4	5	6	7	8	9	10	Average
%	55	40	60	55	45	40	30	20	60	20	41.5

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	10/ss	10/ss	10/ss	10/ss	10/ss	10/ss	10/ss	8/ss	6/ss	2/p	8.6
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	10/ss	10/ss	10/ss	10/ss	10/ss	10/ss	10/ss	10/ss	10/ss	2/p	9.2

Score 9-10 = Riparian Zone > 18 meters
Score 6-8 = Riparian Zone 18 - 12 meters
Note cover type: m=mature forest, ss=shrub/sapling, g=native grass, p=pasture
Score 3-5 = Riparian Zone 11 - 6 meters
Score 1-2 = Riparian Zone < 6 meters

14. Land-Use Stream Impacts

Reach No. - Impact Score											
	1	2	3	4	5	6	7	8	9	10	Average
Impact	0/1	1	1	1	1	1	1	1	1	1	0/1

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other Suburban
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: UTA - 1	Client: EDCC
Stream name: unnamed trib to Flat Creek	Date/Time: 4/18/06 1530
Location: 1	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 8	20 19 18 17 16	15 14 13 12	10 9 (8) 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: UTA - 1	Date/Time: 4/18/06
Stream name: unnamed trib to Flat Creek	Form Completed By: SKH

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 19	(20) 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 7 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 7 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 4 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 9 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 9 RB	Right Bank 10 9	8 7 6	5 4 3	2 1

TOTAL SCORE: 133
AVERAGE SCORE: 13.3

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: UTA-2	**LOCATION:** Just d/s of Hwy 75
STREAM NAME: Unnamed Trib	**RIVER BASIN:** Ouachita
LAT: **LONG:**	**PROJECT:** EDC-46
INVESTIGATORS: CKH/JJF	**DATE/TIME:** 4/19/06 **FORM CHECKED BY:**

WEATHER CONDITIONS

Now	Past 24-hr
☐ storm (heavy rain)	☐
☐ rain (steady rain)	☐
☐ showers (intermittent)	☐
__% ☐ % cloud cover	☐ ____%
☒ clear/sunny	☒

Heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 85 °C (°F)

Other _____

STREAM ATTRIBUTES

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☒ Other Point source discharge

Catchment Area: _____ mi²

Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured? ☒ Yes ☐ No

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest 90% ☒ Sub-Urban 20
☐ Pasture ____% ☒ Commercial 10 %
☐ Row Crops ____% ☒ Industrial 30 %
☒ Urban 10 % ☐ Other _____ %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☒ Mature Forest 40% ☒ Shrub/Sapling 55% ☒ Herbs/Grasses 5% ☐ Turf ____%

STREAM MORPHOLOGY

☐ Riffle ____% ☒ Run 35 % ☒ Pool 65 %

STREAM DISTURBANCES

☒ Roads ☒ Bridges ☐ Pipelines ☐ Beaver Dams ☐ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other _____

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☐ Degrading ☒ Widening ☐ Headcutting

WATER OBSERVATIONS

Water Odors
☐ Normal/None ☐ Sewage
☒ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☒ Sheen ☐ Globs
☐ Flecks ☐ None ☐ Other _____

Turbidity/Water Clarity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☒ Stained ☐ Other _____

SEDIMENT OBSERVATIONS

Sediment Odor
☐ Normal ☐ Sewage ☒ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☐ Other _____

Stream Habitat Assessment (Semi-Quantitative)

Station #: WTA-2	Stream: unnamed Trib	Date/Time: 4/11/06 10 10 -1100	Initials: SKH / JDF
u/s latitude: Bridge / Hwy 75	d/s latitude:	u/s:	
u/s longitude: RR Bridge	d/s longitude:	d/s:	

1. Reach Length Determination

Parameter	Measurement Number / Morph Regime					Average	Total Reach Length (ft)	Sub-Reach Length[2] (ft)
	1/ Run	2/ Pool	3/ Pool	4/ Run	5/ Pool			
Bankfull Width	16.6	15.5	18.0	18.0	23.4	~~21.7~~ 18.3	~~366~~	36.7
Bankfull Depth	1.6	—	—	1.5	—	1.55	na	na

[1]Average width times 20 [2]Total Length divided by 10

NOTE: started Habitat Just u/s of RR Bridge influence

2. Riffle-Pool Sequence

Morph Type	Reach Number - Length in Feet										Total
	1	2	3	4	5	6	7	8	9	10	
Riffle	X	X	X	X	X	X	X	X	X		
Run	X	X	X	X	7.7	36.7	36.7	16.7	X	~~36.7~~	134.5
Pool	36.7	36.7	36.7	36.7	29.0	~~36.7~~	X	20.0	36.7	X	232.5
Sequence[1]	~	~	~	~	~	- - -	- - -	~	~	- - -	n/a

[1]Riffle="xxx", Run="—", Pool="~"

NOTE skipped some Pool ~100'

3. Depth and Width Regime

Morph Type	Reach No. - Average Depth (ft) / Width (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth[3]	1	1	1	1	1	1	1	1	1	1	1
Riffle Width	X	X	X	X	X	X	X	X	X	X	
Run Depth[3]	1	1	1	1	0.9/0.9	1.5/0.3	1.6/0.5	1.4/0.8	1	1.6/1.0	1.44/0.6
Run Width	X	X	X	X	19	17	22	24	X	20	20.4
Pool Depth[3]	2.4/1.3	1.6/1.2	2.4/1.6	2.3/2.0	2.3/1.8	1	1	1.9/0.9	2.2/1.0	1	2.19/1.43
Pool Width	22'	24	24	20	19	X	X	22	22	~~20~~	21.9

[3]Thalwag / Average

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	80	20	40	60	60	20	20	30	20	40	34

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. - Availability and Quality of Fish Habitat										
	1	2	3	4	5	6	7	8	9	10	Average
% Area	40	30	50	70	70	30	20	35	35	50	43

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. - Dominant Substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle	X	X	X	X	X	X	X	X	X	X	—
Run	X	X	X	X	2	2	2	2	X	2	2
Pool	2	2	2	2	2	X	X	2	2	X	2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	11	12	Average
% Embedded													—

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	70	70	70	80	70	30	30	40	70	50	58

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTA 2	Date/Time: 4/19/06 1010	Initials: SKH/JOT

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Morph. Type		Reach No. - Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes	X	X	X	X	X	X	X	X	X	X	X
	Periphyton											
Run	Macrophytes	X	X	X	X	0	0	0	0	X	0	0
	Periphyton					0	0	0	0	X	0	0
Pool	Macrophytes	0	0	0	0	0	X	X	0	0	X	0
	Periphyton	0	0	0	0	0			0	0		0

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. - Percent (%) Shaded Width Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	50	80	90	40	30	10	20	20	80	30	45

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	5	7	7	7	9	9	8	8	8	7	7.5
Slope (°)	75	80	70	70	65	70	80	65	80	80	73.5
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average Score**
Score	7	8	7	8	8	9	8	7	7	7	7.6
Slope (°)	90	90	90	80	90	75	80	75	85	80	83.5

undercut some

Score 9-10 = Stable, < 5% bank affected.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	25	45	20	40	70	80	75	70	30	60	51.5
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
%	50	55	50	40	50	40	50	40	35	45	45.5

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	3/ss	5/ss	5/ss	5/ss	7/ss	8/ss	8/ss	8/ss	9/ss	8/ss	6.6
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average Score**
Score	6/ss	9/m	10/m	10/m	10/m	10/m	10/m/ss	10/m/ss	10/m	10/m	9.5

Score 9-10 = Riparian Zone > 18 meters
Score 6-8 = Riparian Zone 18 - 12 meters
Note cover type: m=mature forest, ss=shrub/sapling, g=native grass, p=pasture
Score 3-5 = Riparian Zone 11 - 6 meters
Score 1-2 = Riparian Zone < 6 meters

14. Land-Use Stream Impacts

Section	Reach No. - Impact Code (0-3)										
	1	2	3	4	5	6	7	8	9	10	Average
Impact	I 2	I 2	I 2	I 2	I 2	I 2	I 2	I 2	I 2	I 2	I 2

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other _____
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: UTA-2	Client: ESC
Stream name:	Date/Time: 4/12/06 1100
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: UTA-2	Date/Time: 4/18/06 1100
Stream name:	Form Completed By: SRH/DDF

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 8 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 8 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 3 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE [illegible] RB	Right Bank 10 9	8 7 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 7 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 10 RB	Right Bank 10 9	8 7 6	5 4 3	2 1

TOTAL SCORE: 102
AVERAGE SCORE: 10.2

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: UTA-3	**LOCATION:**
STREAM NAME: Unnamed Trib	**RIVER BASIN:** Q. River
LAT: **LONG:**	**PROJECT:** EDCC
INVESTIGATORS:	**DATE/TIME:** 4/17/06 1715 **FORM CHECKED BY:**

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
0 % ☐	% cloud cover	☐ ____ %
☑	clear/sunny	☐

Heavy rain in the last 7 days? ☐ Yes ☑ No

Air Temperature 90 °C/°F

Other _____

STREAM ATTRIBUTES

Stream Subsystem
☑ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☑ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☑ Mixture of origins
☐ Swamp and bog ☐ Other _____

Catchment Area: _____ mi²
Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☐ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☑ Low ☐ None

Flows Measured? ☑ Yes ☐ No

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☑ Forest 60 % ☑ Sub-Urban 10
☑ Pasture 30 % ☐ Commercial ____ %
☐ Row Crops ____ % ☐ Industrial ____ %
☐ Urban ____ % ☐ Other _____ %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☑ Industrial Storm Water very little
☑ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☑ Mature Forest 40 % ☑ Shrub/Sapling 20 % ☑ Herbs/Grasses 40 % ☐ Turf ____ %

STREAM MORPHOLOGY

☑ Riffle 5 % ☑ Run 45 % ☑ Pool 50 %

STREAM DISTURBANCES

☑ Roads ☑ Bridges ☐ Pipelines ☐ Beaver Dams ☐ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☑ Other Pasture

Channelized: ☐ Yes ☐ Some ☑ No
Local Watershed Erosion: ☐ None ☑ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☐ Degrading ☑ Widening ☐ Headcutting

WATER QUALITY

Water Odors
☑ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☑ None ☐ Other _____

Turbidity/Water Clarity (If not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☑ Stained ☐ Other _____

SEDIMENT/SUBSTRATE

Sediment Odor
☑ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☑ Sand ☐ Relict shells
☐ Other _____

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTA-3	Stream: unnamed Trib	Date/Time: 4/17/06 (1550)	Initials: SJH/DRF
u/s latitude:	d/s latitude:	u/s:	
u/s longitude:	d/s longitude:	d/s:	

1. Reach Length Determination

Parameter	Measurement Number / Morph Regime					Average	Total Reach Length (ft)	Sub-Reach Length[2] (ft)
	1/ Run	2/ Run	3/ Pool	4/ Run	5/ Run			
Bankfull Width	22.5	17.8	18.5	21.1	17.6	19.5	390	39.0
Bankfull Depth	—	—	2.1	—	2.1	2.1	na	na

[1]Average width times 20 [2]Total Length divided by 10

2. Riffle-Pool Sequence

Morph Type	Reach Number - Length in Feet										
	1	2	3	4	5	6	7	8	9	10	Total
Riffle	X	X	X	X	X	X	X	X	12'	5'	17
Run	X	39'	14'	X	39'	39'	20'	X	8'	18'	177
Pool	39'	X	25	39'	X	X	19'	39'	19'	16'	196
Sequence[1]	~~~	----	---NNF	~~~	----	----	---~~~	~~~	~~~---	~~~	n/a

[1]Riffle="xxx", Run="——", Pool="~~~"

3. Depth and Width Regime

SK: Reach 100 ft of Run; same char. as Reach 5

Morph Type	Reach No. - Average Depth (ft) / Width (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth[3]	X	X	X	X	X	X	X	X	0.8/0.5	0.6/0.4	0.7/0.45
Riffle Width	X	X	X	X	X	X	X	X	10'	12'	11
Run Depth[3]	X	1.3/0.8	1.3/0.8	X	2.0/1.0	1.0/0.6	1.0/0.6	X	1.1/0.7	1.3/0.9	1.30.77
Run Width	X	13'	15'	X	13'	13'	16'	X	16'	16'	14.6
Pool Depth[3]	4.5/2.8'	X	3.0/1.8	2.5/1.4	X	X	2.1/1.3	3.6/2.0	2.7/1.4	2.2/1.7	2.94/1.77
Pool Width	15'	X	16'	19'	X	X	16'	14'	18'	14'	16

[3]Thalwag / Average

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	25	10	20	50	25	40	50	60	50	25	35.5

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. - Availability and Quality of Fish Habitat										
	1	2	3	4	5	6	7	8	9	10	Average
% Area	40	15	20	45	30	40	50	70	60	35	40.5

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. - Dominant substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle	X	X	X	X	X	X	X	X	2	2	2
Run	X	2	2	X	2	2	2	X	2	2	2
Pool	2	X	2	2	X	X	2	2	2	2	2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	11	12	Average
% Embedded	~	~	~	~	~	~	~	~	~	~	~	~	—

8. Sediment Deposition (Percent of Bottom Affected)

	1	2	3	4	5	6	7	8	9	10	Average
%	20	20	25	30	60	30	35	40	40	35	33.5

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTA-3	Date/Time: 4/17/06 (1550-1715)	Initials: JLE

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Mapping Type		Reach No. = Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes	X	X	X	X	X	X	X	X	0	0	0
	Periphyton									0	0	0
Run	Macrophytes	X	0	0	X	0	0	0	X	0	0	0
	Periphyton		0	0		0	0	0		0	0	0
Pool	Macrophytes	0	X	0	0	X	X	0	0	0	0	0
	Periphyton	0		0	0			0	0	0	0	0

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. = Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	40	50	85	20	10	60	60	70	30	45	53

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7	3	5	8	6	6	6	8	6	6	6.1
Slope (°)	70	50	80	70	45	50	80	70	40	80	63.5
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	8	7	6	5	3	5	8	4	6	4	5.6
Slope (°)	60	45	80	85	75	75	75	70	90	75	73.0

Score 9-10 = Stable, < 5% bank affected.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	40	50	30	70	45	40	30	80	20	80	46.5
RB Section	1	2	3	4	5	6	7	8	9	10	Average
%	30	10	60	40	55	50	50	30	80	60	46.5

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	1/g	1/g	1/g	1/g	1/g	2/g	3/g	6/m	8/m	8/m	3.2
RB Section	1	2	3	4	5	6	7	8	9	10	Average
Score	10/m	10/m	9/m	9/m	10/ss	10/ss	10/ss	8/ss	8/ss	8/ss	9.2

Score 9-10 = Riparian Zone > 18 meters
Score 6-8 = Riparian Zone 18 - 12 meters
Note cover type: m=mature forest, ss=shrub/sapling, g=native grass, p=pasture
Score 3-5 = Riparian Zone 11 - 6 meters
Score 1-2 = Riparian Zone < 6 meters

14. Land-Use Stream Impacts

Impact	Reach No. = Impact Score										
	1	2	3	4	5	6	7	8	9	10	Average
Impact	0/2	0/2	0/2	0/2	0/2	0/2	0/2	0/1	0/1	0/1	0/1.7

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other maintained field space trees
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: UTA-3	Client:
Stream name: Unnamed Trib	Date/Time: 4/17/06 (1715)
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: UTA-3	Date/Time: 4/17/06 (1715)
Stream name: Unnamed Trib	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 6 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 6 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 2 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 2 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 3 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 9 RB	Right Bank 10 9	8 7 6	5 4 3	2 1

TOTAL SCORE: 118
AVERAGE SCORE: 11.8

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: UTB-1	**LOCATION:**
STREAM NAME:	**RIVER BASIN:**
LAT: **LONG:**	**PROJECT:**
INVESTIGATORS: SKH/JOF	**DATE/TIME:** 4/20/06 1240 — **FORM CHECKED BY:**

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature _____ °C/°F

Other _____

STREAM ATTRIBUTES

Stream Subsystem (Discharge Ditch)
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☐ Mixture of origins
☐ Swamp and bog ☒ Other Point Source

Catchment Area: _____ mi^2

Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured?
☒ Yes ☐ No

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest 20 %
☐ Pasture ____ %
☐ Row Crops ____ %
☐ Urban ____ %
☐ Sub-Urban
☐ Commercial ____ %
☒ Industrial 50 %
☒ Other Cut over 30 %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☒ Mature Forest 5 % ☒ Shrub/Sapling 85 % ☒ Herbs/Grasses 10 % ☐ Turf ____ %

STREAM MORPHOLOGY

☐ Riffle ____ % ☒ Run 80 % ☒ Pool 20 %

STREAM DISTURBANCES

☐ Roads ☐ Bridges ☐ Pipelines ☐ Beaver Dams ☒ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☐ Other _____

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☒ Minimal ☒ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☒ Degrading ☐ Widening ☐ Headcutting

WATER OBSERVATIONS

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☒ None ☐ Other _____

Turbidity/Water Clarity (if not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☒ Stained ☐ Other _____

SEDIMENT OBSERVATIONS

Sediment Odor
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☐ Other _____

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTB-1	Stream:	Date/Time: 4/20/06 1200	Initials:
u/s latitude:	d/s latitude:	u/s: 1230	
u/s longitude:	d/s longitude:	d/s:	

1. Reach Length Determination

D=0

Parameter	Measurement Number / Morph Regime					Average	Total Reach Length (ft)	Sub-Reach Length (ft)
	1 Run	2 Pool	3 Run	4 Run	5 Pool			
Bankfull Width	8.4	10.0	8.6	6.5	6.0	7.9	158	15.8
Bankfull Depth	1.5	—	1.3	—	—	1.4	na	na

[1] Average width times 20 [2] Total Length divided by 10

Dep

2. Riffle-Pool Sequence

Morph Type	Reach Number - Length in Feet										
	1	2	3	4	5	6	7	8	9	10	Total
Riffle	X	X	X	X	X	X	X	X	X	X	—
Run	X	15.8	15.8	5.8	15.8	15.8	15.8	15.8	15.8	15.8	152.2
Pool	15.8	X	X	10.0	X	X	X	X	X	X	25.8
Sequence[1]	~~~	----	----	~~~	----	----	----	----	----	----	n/a

[1] Riffle="xxx", Run="~~~~", Pool="----"

3. Depth and Width Regime

Morph Type	Reach No. - Average Depth (ft) / Width (ft)										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth[3]	1 / X	1 / X	1 / X	1 / X	1 / X	1 / X	1 / X	1 / X	1 / X	1 / X	1 / —
Riffle Width	X	X	X	X	X	X	X	X	X	X	—
Run Depth[3]	1 / X	0.6 / 5.2	0.9 / 6.0	0.9 / 4.5	1.3 / 5.0	1.4 / 6.0	1.4 / 4.0	1.4 / 5.0	1.0 / 5.0	1.3 / 6.0	1.2 / 5.2
Pool Depth[3]	1.0 / 6.0	1 / X	1 / X	1.4 / 7.0	1 / X	1 / X	1 / X	1 / X	1 / X	1 / X	1.2 / 6.5
Pool Width	6.0	X	X	X	X	X	X	X	X	X	

[3] Thalwag / Average

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	40	20	20	40	40	60	60	40	30	30	3.80

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. - Availability and Quality of Fish Habitat										
	1	2	3	4	5	6	7	8	9	10	Average
% Area	40	25	20	40	30	40	50	30	30	30	33.5

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. - Dominant substrate										
	1	2	3	4	5	6	7	8	9	10	Average
Riffle	X	X	X	X	X	X	X	X	X	X	—
Run	X	2	2	2	2	2	2	2	2	2	2
Pool	2	X	X	2	X	X	X	X	X	X	2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Embedded											

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	50	50	80	60	50	35	30	40	35	50	48

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTB-1	Date/Time: 4/20/06	Initials:

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Morph. Type		Reach No. = Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes	X	X	X	X	X	X	X	X	X	X	—
	Periphyton	X	X	X	X	X	X	X	X	X	X	—
Run	Macrophytes	X	0	0	5	5	5	5	0	0	5	2.4
	Periphyton	X	0	0	0	0	0	0	0	0	0	0
Pool	Macrophytes	5	X	X	0	X	X	X	X	X	X	2.5
	Periphyton	0	X	X	0	X	X	X	X	X	X	0

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. = Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	20	80	10	20.0	0	0	0	5	0	0	6.5

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	6	5	6	6	8	6	6	7	7	7	6.2
Slope (°)	55	80	90	90	85	80	80	80	70	70	75
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average Score**
Score	4	5	6	7	8	5	7	6	5	5	6.3
Slope (°)	90	90	80	45	45	80	90	90	90	90	79

Score 9-10 = Stable, < 5% bank affected.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	35	70	90	50	70	75	70	60	50	20	48
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average**
%	45	70	70	30	30	60	60	50	60	60	53.5

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7/55	5/55	5/55	7/55	7/55	7/55	7/55	7/55	9/55	9/55	6.6
RB Section	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Average Score**
Score	7/55	7/55	3/55	7/55	7/55	7/55	7/55	7/55	10/55	10/55	6.8

Score 9-10 = Riparian Zone > 18 meters
Score 6-8 = Riparian Zone 18 - 12 meters
Note cover type: m=mature forest, ss=shrub/sapling, g=native grass, p=pasture
Score 3-5 = Riparian Zone 11 - 6 meters
Score 1-2 = Riparian Zone < 6 meters

14. Land-Use Stream Impacts

Section	Reach No. = Impact Source										
	1	2	3	4	5	6	7	8	9	10	Average
Impact	I 3	I 3	1	1	1	1	1	1	1	1	I 3

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other _____
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Point Source Discharge

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: UTB-1	Client:
Stream name:	Date/Time: 4/24/06 (12:40)
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: UTB-1	Date/Time: 4/20/06 (12.40)
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity SCORE 11	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line. 20 19 18 17 16	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line. 15 14 13 12 (11)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. 10 9 8 7 6	Channel straight; waterway has been channelized for a distance. 5 4 3 2 1
7. Channel Flow Status SCORE 17	Water reaches base of both lower banks and minimal amount of channel substrate is exposed. 20 19 18 (17) 16	Water fills >75% of the available channel; or < 25% of channel substrate is exposed. 15 14 13 12 11	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed. 10 9 8 7 6	Very little water in channel and mostly present as standing pools. 5 4 3 2 1
8. Bank Stability SCORE 6 LB SCORE 6 RB	Banks stable; no evidence of erosion or bank failure. <5% affected. Left Bank 10 9 Right Bank 10 9	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected. 8 7 6 8 7 6	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods. 5 4 3 5 4 3	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars. 2 1 2 1
9. Vegetative Protection SCORE 2 LB SCORE 3 RB	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally. Left Bank 10 9 Right Bank 10 9	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally. 8 7 6 8 7 6	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. 5 4 3 5 4 3	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height. 2 1 2 1
10. Riparian Vegetative Zone Width SCORE 7 LB SCORE 7 RB	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone. Left Bank 10 9 Right Bank 10 9	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. 8 7 6 8 7 6	Width of riparian zone 6-12 meters; human activities have impacted a great deal. 5 4 3 5 4 3	Width of riparian zone <6 meters; little riparian vegetation to human activities. 2 1 2 1

TOTAL SCORE: 111
AVERAGE SCORE: 11.1

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: UTB-2	**LOCATION:** Downstream of Confluence with EDCC on A-11 001
STREAM NAME: Unnamed Trib	**RIVER BASIN:**
LAT: **LONG:**	**PROJECT:**
INVESTIGATORS: SKH/JBD	**DATE/TIME:** 4/20/06 (1002) **FORM CHECKED BY:**

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature _____ °C/°F

Other _____

STREAM ATTRIBUTES

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☒ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☒ Other Point Source

Catchment Area: _____ mi^2
Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☒ Low ☐ None

Flows Measured?
☒ Yes ☐ No

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest 30 %
☐ Pasture ____ %
☐ Row Crops ____ %
☐ Urban ____ %
☐ Sub-Urban
☐ Commercial ____ %
☒ Industrial 40%
☒ Other Old Cutover 30 %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☒ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☒ Mature Forest 10 % ☒ Shrub/Sapling 70 % ☒ Herbs/Grasses 20 % ☐ Turf ____ %

STREAM MORPHOLOGY

☒ Riffle 5 % ☒ Run 70 % ☒ Pool 25 %

STREAM DISTURBANCES

☐ Roads ☐ Bridges ☒ Pipelines ☐ Beaver Dams ☒ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☒ ATV Crossing ☐ Other _____

Channelized: ☐ Yes ☒ Some ☐ No
Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☐ Aggrading ☒ Degrading ☐ Widening ☐ Headcutting

WATER OBSERVATIONS

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other_____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☒ None ☐ Other_____

Turbidity/Water Clarity (If not measured)
☐ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☒ Stained ☐ Other_____

SEDIMENT OBSERVATIONS

Sediment Odor
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other_____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☐ Other_____

Stream Habitat Assessment (Semi-Quantitative)

Station #: CTB-2	Stream: unnamed Trib	Date/Time: 4/12/06 0845 - 1000	Initials: SKH/DBD
u/s latitude:	d/s latitude:	u/s:	
u/s longitude:	d/s longitude:	d/s:	

1. Reach Length Determination

Parameter	Measurement Number / Morph Regime					Average	Total Reach Length (ft)	Sub-Reach Length[2] (ft)
	1 Pool	2 Run	3 Riffle	4 Pool	5 Riffle			
Bankfull Width	11.5	9.5	12.0	9.0	10.0	10.4	280	28.0
Bankfull Depth	—	1.3	—	1.5	—	1.4	na	na

[1]Average width times 20 [2] Total Length divided by 10

Skipped Pipe Crossing

2. Riffle-Pool Sequence

Morph Type	Reach Number - Length in Feet										Total
	1	2	3	4	5	6	7	8	9	10	
Riffle	X	X	6	X	X	X	X	X	28.0	X [12]	34
Run	X	15.0	22	8.0	28.0	28.0	9.0	28.0	X	28.0 [30]	166
Pool	28.0	13.0	X	20	X	X	19.0	X	X	X [28]	80
Sequence[1]	~~~	~~~	----	~~~	----	----	~~~	----	XXXXX	----	n/a

[1]Riffle="xxx", Run="—", Pool="~~"

3. Depth and Width Regime

Morph Type	Reach No. - Average Depth (ft) / Width (ft)										Average
	1	2	3	4	5	6	7	8	9	10	
Riffle Depth[3]	1	1	0.7/0.3	1	1	1	1	1	0.5/0.3	1	0.6/0.3
Riffle Width	X	X	9.0	X	X	X	X	X	8.5	X	8.75
Run Depth[3]	1	1.0/0.8	1.0/0.8	0.4/0.4	0.8/0.5	0.8/0.5	0.8/0.5	0.9/0.6	1	0.7/0.3	0.83/0.55
Run Width	X	6.0	6.0	7.0	7.0	6.0	8.0	8.0	X	6.0	6.5
Pool Depth[3]	1.5/1.0	1.6/0.8	1	0.9/0.6	1	X	1.7/1.4	1	1	1	1.43/0.7
Pool Width	8.5	6.0	X	8.0	X	X	9.0	X	X	X	7.63

[3]Thalwag / Average

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	50	60	40	30	20	35	30	45	10	10	32

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. - Availability and Quality of Fish Habitat										Average
	1	2	3	4	5	6	7	8	9	10	
% Area	40	60	40	30	20	35	35	50	10	10	3.3

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. - Dominant substrate										Average
	1	2	3	4	5	6	7	8	9	10	
Riffle	X	X	2	X	X	X	X	X	2	X	2
Run	X	2	2	2	2	2	2	2	X	1	1.6
Pool	2	2	X	2	X	X	2	X	X	X	2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	11	12	Average
% Embedded													

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	80	30	40	60	90	70	50	30	50	30	53

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTB-2	Date/Time: 4/20/06 0845 - 1000	Initials: SLH / JBB

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Morph. Type		Reach No. - Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes	X	X	0	X	X	X	X	X	0	X	0
	Periphyton			0						0		0
Run	Macrophytes	X	0	0	0	0	5	5	X	X	5	2.14
	Periphyton		0	0	0	0	0	0	0	0	0	0
Pool	Macrophytes	0	0	X	0	X	X	5	X	X	X	1.25
	Periphyton	0	0		0			0				0

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. - Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	5	30	30	35	60	5	5	5	20	20	21.5

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7	8	8	5	5	4	4	4	6	6	5.7
Slope (°)	60	45	40	80	80	50	45	40	80	45	56.5
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	6	8	6	7	8	7	7	5	6	7	6.7
Slope (°)	80	90	80	80	65	80	80	90	85	60	77

Score 9-10 = Stable, < 5% bank affected.
Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding.
Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	60	65	55	70	40	30	40	40	60	60	52
RB Section	1	2	3	4	5	6	7	8	9	10	Average
%	75	75	60	55	60	50	50	40	40	45	55

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	1/ss	1/ss	1/ss	1/ss	1/ss	1/ss	1/ss	1/ss	1/ss	1/ss	1/ss
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	3/ss	3/ss	2/ss	2/ss	1/ss	1/ss	1/ss	1/ss	6/ss	7/ss	2.7/ss

Score 9-10 = Riparian Zone > 18 meters
Score 6-8 = Riparian Zone 18 - 12 meters
Note cover type: m=mature forest, ss=shrub/sapling, g=native grass, p=pasture
Score 3-5 = Riparian Zone 11 - 6 meters
Score 1-2 = Riparian Zone < 6 meters

14. Land-Use Stream Impacts

Section	Reach No. - Impact Score										
	1	2	3	4	5	6	7	8	9	10	Average
Impact	3	1	1	1	1	1	1	1	1	1	1.3

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other Powerlines Right-of-way
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Notice Kipper Pipeline Crossing

Pipeline Crossing

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: UTB-2	Client:
Stream name:	Date/Time: 4/20/06 – 1000
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: UTB2	Date/Time: 4/20/06 1000
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 13	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 15	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 6 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 3 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 3 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 1 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 3 RB	Right Bank 10 9	8 7 6	5 4 3	2 1

TOTAL SCORE: _____
AVERAGE SCORE: _____

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

GENERAL PHYSICAL CHARACTERIZATION FIELD FORM

STATION I.D: UTC-1	**LOCATION:**
STREAM NAME:	**RIVER BASIN:**
LAT: **LONG:**	**PROJECT:**
INVESTIGATORS: SPH/JDF	**DATE/TIME:** 4/20/06 **FORM CHECKED BY:**

WEATHER CONDITIONS

Now		Past 24-hr
☐	storm (heavy rain)	☐
☐	rain (steady rain)	☐
☐	showers (intermittent)	☐
__% ☐	% cloud cover	☐ ____%
☒	clear/sunny	☒

Heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature _____ °C/°F

Other _____

STREAM ATTRIBUTES

Stream Subsystem
☐ Perennial ☒ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Montane, non-glacial ☒ Mixture of origins
☐ Swamp and bog ☐ Other _____

Catchment Area: _____ mi^2

Stream Order: _____

Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)

HYDROLOGY

Flows
☐ High ☐ Moderate ☒ Low (very low) ☒ None

Flows Measured? ☒ Yes ☐ No

Reach: Slope & Sinuosity
_____ ft/mi _____

WATERSHED FEATURES

Predominant Surrounding Landuse
☒ Forest 70 %
☐ Pasture ____ %
☐ Row Crops ____ %
☐ Urban ____ %
☐ Sub-Urban
☐ Commercial ____ %
☒ Industrial 30 %
☐ Other _____ %

Local Watershed NPS Pollution
☐ No evidence ☐ Agricultural
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water

RIPARIAN VEGETATION

☒ Mature Forest 10 % ☒ Shrub/Sapling 85 % ☒ Herbs/Grasses 5 % ☐ Turf ____ %

STREAM MORPHOLOGY

☒ Riffle 25 % ☒ Run 375 % ☐ Pool 60 %

STREAM DISTURBANCES

☐ Roads ☐ Bridges ☐ Pipelines ☐ Beaver Dams ☐ Point Source
☐ Dams ☐ Trash ☐ Cattle Access ☐ Mining ☐ ATV Crossing ☒ Other old cutover

Channelized: ☐ Yes ☐ Some ☒ No
Local Watershed Erosion: ☐ None ☒ Minimal ☐ Moderate ☐ Heavy
Channel Dynamics: ☒ Aggrading ☐ Degrading ☐ Widening ☐ Headcutting

WATER OBSERVATIONS

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☒ None ☐ Other _____

Turbidity/Water Clarity (if not measured)
☐ Clear ☐ Slightly turbid ☒ Turbid
☐ Opaque ☐ Stained ☐ Other _____

SEDIMENT OBSERVATIONS

Sediment Odor
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Sediment Deposits
☐ Sludge ☐ Sawdust ☐ Oils
☒ Sand ☐ Relict shells
☐ Other _____

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTC-1	Stream:	Date/Time: 7/24/16 1100	Initials: SK/JDF
u/s latitude:	d/s latitude:	u/s: 1145	
u/s longitude:	d/s longitude:	d/s:	

1. Reach Length Determination

Parameter	Measurement Number/Morph Regime 1	2	3	4	5	Average	Total Reach Length[1] (ft)	Sub Reach Length[2] (ft)
Bankfull Width	9.8	9.7	6.0	5.0	5.5	7.2	144	14.4
Bankfull Depth	—	—	1.3	—	1.0	1.15	na	na

[1]Average width times 20 [2] Total Length divided by 10

2. Riffle-Pool Sequence

Morph Type	Reach Number - Length in Feet 1	2	3	4	5	6	7	8	9	10	Total
Riffle	X	X	X	X	X	X	X (STOP)	1.0	X	X	1.0
Run	X	7	14.4	X	14.4	14.4	X	11.4	X	10	71.6
Pool	14.4	7.4	X	14.4	X	X	14.4	2.0	14.4	4.4	71.4
Sequence[1]	~~~	~~~	---	~~~	---	~~~	~~~	xx--	~~~	---~	n/a

[1]Riffle="xxx", Run="~~~", Pool="---"

3. Depth and Width Regime

Morph Type	Reach No. - Average Depth (ft) / Width (ft) 1	2	3	4	5	6	7	8	9	10	Average
Riffle Depth[3]	1	1	1	1	1	1	1	0.2/0.1	1	1	0.2/0.1
Riffle Width	X	X	X	X	X	X	X	1.0	X	X	1.0
Run Depth[3]	1	0.7/0.4	0.8/0.5	1	0.4/0.2	0.5/0.3	1	0.3/0.2	1	0.4/0.2	0.52/0.3
Run Width	X	4.0	4.8	X	3.5	2.0	X	2.0	X	4.0	3.3
Pool Depth[3]	1.0/0.5	0.6/0.4	1	0.5/0.3	1	1.2/0.8	0.7/0.4	0.8/0.4	1.0/0.6	1.1/0.5	0.86/0.49
Pool Width	5.5	5.0	X	6.0	X	8.0	5.0	4.0	5.5	8.0	5.9

[3]Thalwag / Average

4. Epifaunal Substrate, Percent Stable Habitat (for Macroinvertebrates)

Section	1	2	3	4	5	6	7	8	9	10	Average
% Area	30	30	20	30	50	30	50	10	25	25	30

5. In-Stream Habitat, Percent Stable Habitat (Available Fish Cover in Wetted Perimeter)

Section	Reach No. - Availability and Quality of Fish Habitat 1	2	3	4	5	6	7	8	9	10	Average
% Area	30	30	20	40	40	50	50	10	30	35	33.5

6. Substrate Characterization (Dominant Substrate)

Morph Type	Reach No. - Dominant Substrate 1	2	3	4	5	6	7	8	9	10	Average
Riffle	X	X	X	X	X	X	X	1	X	X	1
Run	2	2	2	X	3	3	X	1	X	2	2.2
Pool	2	2	X	2	X	2	2	2	2	2	2

BR=Bedrock(7), BLD=Boulder(6), COB=Cobble(5), GC=Gravel Coarse(4), GF=Gravel Fine(3), S=Sand(2), SC=Silt/Clay(1)

7. Embeddedness (Gravel, Cobble, Boulders Percent Embedded)

Section	1	2	3	4	5	6	7	8	9	10	11	12	Average
% Embedded													

8. Sediment Deposition (Percent of Bottom Affected)

Section	1	2	3	4	5	6	7	8	9	10	Average
%	30	20	30	50	30	20	20	0	10	35	24.5

Stream Habitat Assessment (Semi-Quantitative)

Station #: UTC-1	Date/Time: 4/20/06	Initials:

9. Aquatic Macrophytes and Periphyton (Percent Coverage)

Morph. Type		Reach No. – Percent Coverage										
		1	2	3	4	5	6	7	8	9	10	Average
Riffle	Macrophytes	X	X	X	X	X	X	X	0	X	X	0
	Periphyton								0			0
Run	Macrophytes	X	5	5	X	5	0	X	0	X	5	3.3
	Periphyton		0	0		0	0		0		0	0
Pool	Macrophytes	0	5	X	0	X	0	0	0	5	5	1.9
	Periphyton	0	0	X	0		0	0	0	0	0	0

10. Canopy Cover (Percent Stream Shading)

Section	Reach No. – Percent (%) Shaded Within Stream Channel										
	1	2	3	4	5	6	7	8	9	10	Average
Shading	15	20	40	35	10	60	30	20	10	25	26.5

11. Bank Stability (Score) and Slope (Degrees)

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	6	8	9	9	5	7	9	8	7.0	7	7.5
Slope (°)	85	60	45	30	90	45	60	60	70	50	59.5
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	9	9	8	7	8	5	5	6	7.0	7	7.1
Slope (°)	20	45	65	90	45	80	90	75	70	70	65

Score 9-10 = Stable, < 5% bank affected. Score 6-8 = Moderately stable, 5-29% of bank eroding
Score 3-5 = Moderately unstable, 30-59% bank eroding. Score 1-2 = Unstable, 60-100% bank eroding.

12. Vegetative Protection (Percent Banks Protected)

LB Section	1	2	3	4	5	6	7	8	9	10	Average
%	65	80	60	20	35	20	75	50	30	50	50.5
RB Section	1	2	3	4	5	6	7	8	9	10	Average
%	60	55	50	70	50	30	50	60	30	40	49.5

13. Riparian Vegetative Zone Width

LB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	3/ss	3/ss	3/ss	3/ss	3/ss	3/ss	7/ss	7/ss	7/ss	7/ss	4.8/ss
RB Section	1	2	3	4	5	6	7	8	9	10	Average Score
Score	7/ss	7/ss	7/ss	7/ss	7/ss	7/ss	7/ss	7/ss	7/ss	7/ss	7/ss

Score 9-10 = Riparian Zone > 18 meters Score 6-8 = Riparian Zone 18 - 12 meters Note cover type: m=mature forest,
Score 3-5 = Riparian Zone 11 - 6 meters Score 1-2 = Riparian Zone < 6 meters ss=shrub/sapling, g=native grass, p=pasture

14. Land-Use Stream Impacts

Section	Reach No. – Impact Score										
	1	2	3	4	5	6	7	8	9	10	Average
Impact	I/1	I/1	I/1	I/1	I/1	I/1	I/1	I/1	I/1	I/1	I/1

C = Cattle R = Row Crops U = Urban Encroachment I = Industrial Encroachment O = Other _____
Score 0 = none 1 = minor affect 2 = moderate affect 3 = major affect

Habitat Assessment Field Data Sheet (Low Gradient)

Station I.D: UTC-1	Client:
Stream name:	Date/Time: 4/20/06 (1145)
Location:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate / Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble, or other stable habitat; and at a stage to allow full colonization.	30-50% mix of stable habitat suited for colonization; adequate habitat for maintenance of population; some newfall may be present.	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed.	Less than 10% stable habitat; lack of habitat obvious; substrate lacking..
SCORE 11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay to sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root or vegetation.
SCORE 12	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
3. Pool Variability	Even mix of large-shallow, large-deep small-shallow, small deep pools present.	Majority of pools large deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or absent.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
4. Channel Alteration	No channelization or dredging present. Stream channel normal.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yrs.) may be present, but recent channelization is not present.	Embankments present on both banks; channelization may be extensive, and 40%-80% of steam reach channelized and disrupted.	Extensive channelization; shored with Gabon cement; heavily urbanized areas; in steam habitat greatly altered or removed entirely.
SCORE 17	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of islands or point bars.	20-50% affected; some accumulation; substantial sediment movement only during major storm even; some new increase in bar formation.	50-80% affected; moderate deposition; pools shallow, moderately silted; embankments may be present on both banks; frequent and substantial sediment movement during storm events.	Heavily silted; >80% affected; movement/shifting of bottom occurs frequently; pools nearly absent due to deposition.
SCORE 15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat Assessment Field Data Sheet (Low Gradient Cont.)

Station I.D: UTC-1	Date/Time: 9/20/06 1145
Stream name:	Form Completed By:

Habitat Parameter	CATEGORY			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than it if was in a straight line.	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a distance.
SCORE 11	20 19 18 17 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1
7. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 (6)	5 4 3 2 1
8. Bank Stability	Banks stable; no evidence of erosion or bank failure. <5% affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5%-30% affected.	Moderately unstable; up to 30%-60% of banks in reach show areas of erosion. High erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of banks have erosion scars.
SCORE 8 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
9. Vegetative Protection	More than 90% of the streambank surfaces and immediate riparian zone covered by vegetation. Vegetation disruption minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by vegetation. Disruption minimal or not evident; one group of plants likely not evident. Almost all plants allowed to grow naturally.	50-70% of the streambank surfaces covered by vegetation. Disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of streambank surfaces covered by vegetation. Disruption of stream bank vegetation very high; vegetation has been removed; 2 inches or less average stubble height.
SCORE 3 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 3 RB	Right Bank 10 9	8 7 6	5 4 3	2 1
10. Riparian Vegetative Zone Width	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted a great deal.	Width of riparian zone <6 meters; little riparian vegetation to human activities.
SCORE 5 LB	Left Bank 10 9	8 7 6	5 4 3	2 1
SCORE 7 RB	Right Bank 10 9	8 7 6	5 4 3	2 1

TOTAL SCORE: _____
AVERAGE SCORE: _____

Barbour, M.T. et.al., 1999. *Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers.*

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Flat Creek
Client: EDCC
Project no: 2042-06-070
Investigators: REM, SKH, JBB, JOF
Date Sample Collected: 4/17/06
Habitat Forms Completed: (yes) / no

Location: FC-2 / FC-1
Ecoregion: Gulf Coastal
Weather: Partly cloudy, mostly clear, hot
Form Completed By: JBB
Form Checked By: ______
Fish Sampling Completed: (yes) / no

Collection Site Observations		
Flat Creek	FC-1 Above Station	FC-2 Below Station
Total Time Sampled	5m AAH	5min pol AAH
Relative Abundance of Aquatic Biota		
Periphyton:	(0) 1 2 3 4	(0 1) 2 3 4
Filamentous Algae:	(0) 1 2 3 4	(0) 1 2 3 4
Macrophytes:	0 (1) 2 3 4	(0) 1 2 3 4
Slimes:	(0) 1 2 3 4	(0) 1 2 3 4
Macroinvertebrates:	0 1 2 (3) 4	0 1 2 (3) 4
Fish:	0 1 (2) 3 4	0 1 (2) 3 4
Other______:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:	25	10
Shallow Pool:	60	~~[illegible]~~ 75
Deep Pool:	10	15
Backwaters:	5	
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:	40	30
Emergent Vegatation:		
Submerged Vegetation:		
Depositional Area:	10	30
Overhanging Veg:		
Root Wads:	25	15
Undercut Banks:	20	20
Filamentous algae:		
Leafy Debris:	5	5
Other______:		

Macroinvertebrate Qualitative Sample List		
Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant
Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:
Sampled all habitats. Midchannel mostly hardpan clay. Abundant instream woody debris, some Run out of beaver dam with clean sand (Ophiogomphus), Odonates dominated

Larmar Bryant
242 Old Calion Road
Eld 71730
Land owner stopped

Rapid Bioassessment Field Sheet

Point Source ~~Home~~ Reference site FC-2 Date 4/17/06

Collector REM Sample Technique S. MAAH Sediment no

Habitat Description: ABOVE sandy - wide stream bed, steep banks, no multiple channels old channelized??

BELOW Abundant woody debris, clay hardpan dominant substrate, multiple channels, beaver dams

Below

MACROINVERTEBRATE COMMUNITY

~~ABOVE~~ Station # FC-2

Cnt.	Taxa	Tally
6	enallagma	HH I
18	~~Argia~~ Argia	HH HH HH III
9	Ophigomphus	HH IIII
18	Canis	HH HH HH III
4	Amphipoda	IIII
11	Hydropsyche	HH HH I
1	pelodytes	I
2	Nachromia	II
10	Chironomidae	HH HH
3	Calopteryx	III
2	Gomphus	II
1	Sialis	I
1	Camberine	I
4	Bezzia (Pro)	IIII
1	Hagenius	I
1	Aeshna (Boyeria)	I
15	Cheumatopsyche	HH HH HH
3	Corbicula	III
2	Isopoda	II

19 Tx :TOTAL: 100

~~BELOW~~ Station # FC-1

Cnt.	Taxa	Tally
14	Enallagma	HH HH IIII
21	Argia	HH HH HH I
2	Ophigomphus	II
20	~~Canis~~ Caenis	HH HH HH
9	Amphipoda	HH IIII
7	Hydropsyche	HH II (Cheumatopsyche)
12	Chironomidae	HH HH II
3	Camberine	III
1	Bezzia (Pro)	I
2	Isopoda	II
2	Stelemis	II
2	Physa	II
2	Diptera Taxa 1	II
3	Cirbicula	III

19 Tx :TOTAL: 100 TAXA

Community Structure

	ABOVE	BELOW		ABOVE	BELOW
% Ephem.			% Odon.		
% Plecop.			% Cole.		
% Trichop.			% Crustacea		
% EPT					
% Chir.			# of Taxa:		
% Diptera			Biotic Score:		

Comments:

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: UTA-1

Location: UTA-1

Client: EDCC

Ecoregion: SoMA Coastal

Project no: 2042-06-070

Weather: Sunny, Cool

Investigators: KEM, SKH, JAB, JJF

Form Completed By: JAB

Date Sample Collected: 4/14/09

Form Checked By: _____

Habitat Forms Completed: (yes) / no

Fish Sampling Completed: (yes) / no

Collection Site Observations		
	Above Station	Below Station
Total # Taxa Sampled:		
Relative Abundance of Aquatic Biota		
Periphyton:	(0) 1 2 3 4	0 1 2 3 4
Filamentous Algae:	0 1 (2) 3 4	0 1 2 3 4
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4
Slimes:	(0) 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 (2) 3 4	0 1 2 3 4
Fish:	0 1 2 (3) 4	0 1 2 3 4
Other_____:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:		
Shallow Pool:		
Deep Pool:	100 %	
Backwaters:		
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:	10	
Emergent Vegatation:		
Submerged Vegetation:		
Depositional Area:		
Overhanging Veg:		
Root Wads:	30	
Undercut Banks:	50	
Filamentous algae:		
Leafy Debris:	10	
Other_____:		

Macroinvertebrate Qualitative Sample List		
Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant

Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

UTA-1

Rapid Bioassessment Field Sheet

Point Source _____ Date 4/18/06

Collector REM Sample Technique SMAAH Sediment Mouse

Habitat Description: ABOVE Deep pools, collections made in root wads, Emergent vegetation limited

BELOW _____

MACROINVERTEBRATE COMMUNITY

ABOVE Station # UTA-1

Cnt.	Taxa	Tally
1	Boyeria vinosa	/
11	Beezia	
8	Hesia	
30	Cunis	
17	Amphipoda	
10	Micronemedea	
1	Corduldia	/
1	Hexatoma	/
5	Enallagma	
4	Sciteby	
1	Fingernail Clam	/
2	Physa	//
1	Leech	/
1	Callibetis	/
2	Orthocladiinae	//
1	Petrodytes	/
2	Libellula	//
1	Corduliia	/
1	Palomentes	/
1	Isopoda	/
1	Hyaella	/
1	Hairy ??	/
1	Hydrea?	/
23	:TOTAL:	

BELOW Station # ~~UTA-1~~ start 1570 stop 1600

Cnt.	Taxa	Tally
	:TOTAL:	

Community Structure

	ABOVE	BELOW		ABOVE	BELOW
% Ephem.			% Odon.		
% Plecop.			% Cole.		
% Trichop.			% Crustacea		
% EPT					
% Chir.			# of Taxa:		
% Diptera			Biotic Score:		

Comments:

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: UTA-2 Unnamed Trib. Location: UTA-2

Client: EDCC Ecoregion: Gulf Coastal

Project no: 2042-06-070 Weather: Sunny, Hot

Investigators: REM, SEH, JBB, JJF

Form Completed By: JBB

Date Sample Collected: 4/18/06 Form Checked By: _____

Habitat Forms Completed: (yes) / no Fish Sampling Completed: (yes) / no

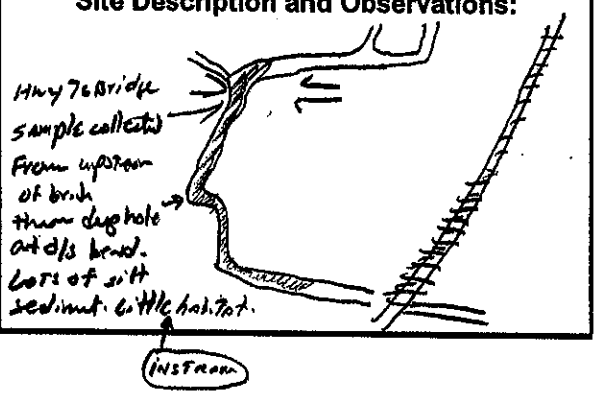
Collection Site Observations		
	Above Station	Below Station
Clock Time Sampled:		SMAAH
Relative Abundance of Aquatic Biota		
Periphyton:	(0) 1 2 3 4	0 1 2 3 4
Filamentous Algae:	(0) 1 2 3 4	0 1 2 3 4
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4
Slimes:	(0) 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4
Fish:	0 1 2 (3) 4	0 1 2 3 4
Other_____:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:	20	
Shallow Pool:	~~50~~ 65	
Deep Pool:		
Backwaters:	15	
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:	30	
Emergent Vegatation:	10	
Submerged Vegetation:		
Depositional Area:	20	
Overhanging Veg:	20	
Root Wads:		
Undercut Banks:	20	
Filamentous algae:		
Leafy Debris:		
Other_____:		

Macroinvertebrate Qualitative Sample List		
Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant

Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:



Rapid Bioassessment Field Sheet

Point Source _____ Date 4/18/06

Collector REM Sample Technique SMAA17 Sediment No

Habitat Description: ABOVE _____

BELOW Silt dominated, limited habitat

MACROINVERTEBRATE COMMUNITY

Start 10:[illegible]

ABOVE Station # _____

Cnt.	Taxa	Tally

BELOW Station # UTA-2

Cnt.	Taxa	Tally
5	Argia	IIII
15	Isopoda	IIII IIII IIII
2	Anaphoryx	II
1	Ranatra	I
10	Chironomidae	IIII IIII
1	Dytiscid	I
6	Uvarus	IIII I
14	Amphipoda	IIII IIII IIII
1	Dytiscid beetle I	I
9	Cambarinae	IIII IIII
13	Canis	IIII IIII III
2	Leech	II
6	Corixidae	IIII I
1	Ophiogomphus	I
1	Dineutus	I
2	Fossa magna	II
4	Pelthydytes	IIII
1	Berosus	I
2	Oligocheata	II
1	Gomphus	I
2	Bezzia	II
1	Culicidae	I

	:TOTAL:		100	:TOTAL:	22 Taxa

Community Structure

	ABOVE	BELOW		ABOVE	BELOW
% Ephem.			% Odon.		
% Plecop.			% Cole.		
% Trichop.			% Crustacea		
% EPT					
% Chir.			# of Taxa:		
% Diptera			Biotic Score:		

Comments:

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: Unnamed Trib UTA-3 Location: UTA-3

Client: EDCC Ecoregion: South Coastal

Project no: 2042-06-070 Weather: Sunny, Hot

Investigators: REM, SKH, JBB, JJF

Form Completed By: JBB

Date Sample Collected: 4/17/06 Form Checked By: _____

Habitat Forms Completed: (yes) / no Fish Sampling Completed: (yes) / no

Collection Site Observations			Macroinvertebrate Qualitative Sample List		
	Above Station	Below Station	Taxa	Above Station	Below Station
Relative Abundance of Aquatic Biota			Annelida		
			Decapoda		
Periphyton:	(0) 1 2 3 4	0 1 2 3 4	Gastropoda		
Filamentous Algae:	(0) 1 2 3 4	0 1 2 3 4	Pelecypoda		
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4	Hemiptera		
Slimes:	(0) 1 2 3 4	0 1 2 3 4	Coleoptera		
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4	Lepidoptera		
Fish:	0 1 2 (3) 4	0 1 2 3 4	Odonata		
Other_____:	0 1 2 3 4	0 1 2 3 4	Megaloptera		
			Diptera		
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			Chironomidae		
Major Habitat Sampled (%)			Plecoptera		
Riffle/Run:	5%		Ephemeroptera		
Shallow Pool:	80%		Trichoptera		
Deep Pool:			Amphipoda		
Backwaters:	15%				
Chanelized:					
Microhabitats Sampled (%)					
Woody Debris:	10		R=Rare, C=Common, A=Abundant, D=Dominant		
Emergent Vegatation:			Rare<3, Common 3-9, Abundant>10, Dominant>50		
Submerged Vegetation:			**Site Description and Observations:**		
Depositional Area:	10				
Overhanging Veg:					
Root Wads:	50				
Undercut Banks:	10				
Filamentous algae:					
Leafy Debris:	20				
Other_____:					

Cypress knees abundant
Limited root wads, Fish habitat abundant, Depositional area
Root wads large % of sample.
Sediment mostly sand/HPCL

Rapid Bioassessment Field Sheet

Point Source UTA-3 Date 4/17/06
Collector RKW Sample Technique SMAAH Sediment ?
Habitat Description: ABOVE
BELOW UTA-3 - SMAAH ⇒ just u/s o'neal Rd

MACROINVERTEBRATE COMMUNITY

ABOVE Station # UTA-3

Cnt.	Taxa	Tally
4	Amphipoda	IIII
3	Palaemonetes	III
6	Isopoda	IIII
3	Leech	III
8	Cambarinae	IIIIII
2	Oligochaeta	II
1	Hexagenia bilineata	I
5	Atrida	IIII
2	Macromia	II
5	Calopteryx	IIII
12	Caenis	IIII IIII II
3	Corydalidae	III (Neurocordulia)
6	Chimarropsyche	IIII
4	Hydrophilidae (L)	IIII (Berosus)
1	Hydroporus	I
1	Polycentropus	I
3	Perlodytes	III
4	Stenelmis	IIII
2	Anacroneyx	II
4	Simlis	IIII
~~5~~	~~Boreus~~	~~IIII~~ REV
5	Hexatoma	IIII
15	Chironomidae	IIII IIII IIII
3	Simulium	III
3	Culicidae	III (Anopheles)

BELOW Station #

Cnt.	Taxa	Tally

25TAXA	:TOTAL:	102
	:TOTAL:	

Community Structure

	ABOVE	BELOW		ABOVE	BELOW
% Ephem.			% Odon.		
% Plecop.			% Cole.		
% Trichop.			% Crustacea		
% EPT					
% Chir.			# of Taxa:		
% Diptera			Biotic Score:		

Comments:

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: UTB-1

Location: Gulf Coastal -

Client: EDCC

Ecoregion: -

Project no: 2042-06-070

Weather: Partly Cloudy / Rain Threat

Investigators: REW, SKH, JJF, JBB

Form Completed By: REW

Date Sample Collected: 9/20/2006

Form Checked By: _____

Habitat Forms Completed: yes / no

Fish Sampling Completed: yes / no

Collection Site Observations		
	Above Station	Below Station
Waterbody Sampled:	UTB-1	
Relative Abundance of Aquatic Biota		
Periphyton:	(0) 1 2 3 4	0 1 2 3 4
Filamentous Algae:	(0) 1 2 3 4	0 1 2 3 4
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4
Slimes:	(0) 1 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 (2) 3 4	0 1 2 3 4
Fish:	0 1 (2) 3 4	0 1 2 3 4
Other_____:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:	100% Run	
Shallow Pool:		
Deep Pool:		
Backwaters:		
Chanelized:		
Microhabitats Sampled (%)		
Woody Debris:		
Emergent Vegatation:	30	
Submerged Vegetation:		
Depositional Area:		
Overhanging Veg:	60	
Root Wads:	10	
Undercut Banks:		
Filamentous algae:		
Leafy Debris:		
Other_____:		

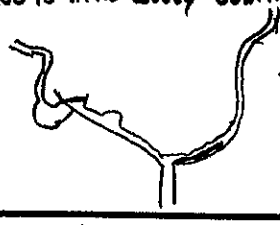
Macroinvertebrate Qualitative Sample List		
Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant

Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

100% run. some deeper but none over 2 ft.
Sample reach ~200 yds u/s of confluence w/ UTC
-NOTE no to little woody debris. grass clumps.



reach upstream through clay bed pool with little instream woody debris

Rapid Bioassessment Field Sheet

Point Source Unnamed tributary to EDonnels Chemical Company discharge 001 Date 4/20/06 1215
Collector RBM Sample Technique Smooth Sediment ?
Habitat Description: ABOVE UTB-1

BELOW

MACROINVERTEBRATE COMMUNITY

ABOVE Station # UTB-1

Cnt.	Taxa	Tally
7	Amphipoda	
2	Oligochaeta	
2	Arcia	
1	Leeche	
9	Enallagma	
6	Corixidae	
17	D. (larvae)	
3	Dineutus (larvae)	
3	Anacroneuria (larvae)	
2	Stenelmis (larvae)	
1	Dytiscidae	(Hydroporus)
3	Sirdes	
16	Gyrinus	
3	Simulium	
37	Chaeborus	
4	Tanypodinae	
10	Chironominae	
6	Orthocladinae	
18	:TOTAL: 108	

BELOW Station #

Cnt.	Taxa	Tally
	:TOTAL:	

Community Structure

	ABOVE	BELOW
% Ephem.		
% Plecop.		
% Trichop.		
% EPT		
% Chir.		
% Diptera		

	ABOVE	BELOW
% Odon.		
% Cole.		
% Crustacea		
# of Taxa:		
Biotic Score:		

Comments:

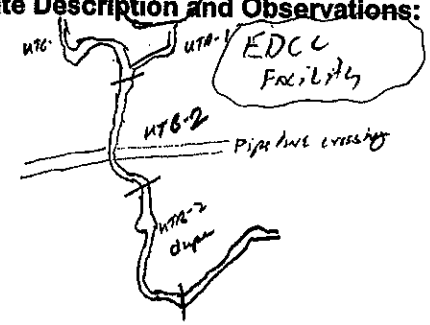
FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: UTB-2 EDCC EFFLUENT DIKE
Client: EDCC
Project no: 2042-06-070
Investigators: REM, JKH, JJF, JBB
Date Sample Collected: 4/20/06

Location: _____
Ecoregion: GULF COASTAL
Weather: PARTLY CLOUDY - RAIN THREAT
Form Completed By: REM
Form Checked By: _____
Habitat Forms Completed: yes / no
Fish Sampling Completed: (yes) / no

Collection Site Observations			Macroinvertebrate Qualitative Sample List		
	Above Station	Below Station	Taxa	Above Station	Below Station
Major Habitat Sampled	UTB-2	UTB-2 dpn	Annelida		
Relative Abundance of Aquatic Flora			Decapoda		
Periphyton:	(0) 1 2 3 4	(0) 1 2 3 4	Gastropoda		
Filamentous Algae:	(0) 1 2 3 4	0 (1) 2 3 4	Pelecypoda		
Macrophytes:	0 (1) 2 3 4	0 1 (2) 3 4	Hemiptera		
Slimes:	(0) 1 2 3 4	0 (1) 2 3 4	Coleoptera		
Macroinvertebrates:	0 (1) 2 3 4	0 1 (2) 3 4	Lepidoptera		
Fish:	0 (1) 2 3 4	0 (1) 2 3 4	Odonata		
Other_____:	0 1 2 3 4	0 1 2 3 4	Megaloptera		
			Diptera		
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			Chironomidae		
Major Habitat Sampled (%)			Plecoptera		
Riffle/Run:	NA / 100	80	Ephemeroptera		
Shallow Pool:		20	Trichoptera		
Deep Pool:			Amphipoda		
Backwaters:					
Chanelized:					
Microhabitats Sampled (%)					
Woody Debris:		5	R=Rare, C=Common, A=Abundant, D=Dominant		
Emergent Vegatation:	5	5	Rare<3, Common 3-9, Abundant>10, Dominant>50		
Submerged Vegetation:					
Depositional Area:		10			
Overhanging Veg:	60 65 Rm	90			
Root Wads:	20	10			
Undercut Banks:					
Filamentous algae:					
Leafy Debris:	10				
Other_____:					

Site Description and Observations:



Rapid Bioassessment Field Sheet

Point Source UTB-2: EOCC EFFLUENT DITCH d/s mouth UTC Date 4/20/06
Collector REV Sample Technique SMAHH Sediment ? NONE collected
Habitat Description: ABOVE

BELOW @UTB-2

MACROINVERTEBRATE COMMUNITY

ABOVE Station # UTB-2

Cnt.	Taxa	Tally
5	Amphipoda	HHT
3	Cambaridae	III
6	Isopoda	HHT/
6	Argia	HHT/
3	Enallagma	III
14	Corixidae	HHT HHT IIII
6	Dineutus	HHT/
18	Dineutus (larvae)	HHT HHT IIII
4	Uvarus	IIII
9	Dytiscidae (LARVAE)	HHT//
17	Chaoborus	HHHT HHT HHT HHT II
4	Stenelmis	IIII
5	Anaroneyx	HHT
4	Cheumatopsyche	IIII
3	Simulium	III
12	Chironomidae	
	Chironominae	HHT III
	Orthocladinae	II
	Tanypodinae	II
	:TOTAL:	

BELOW Station # UTB-2 (dupe)

Cnt.	Taxa	Tally
21	Amphipoda	HHT HHT HHT HHT /
11	Isopoda	HHT HHT /
1	Enallagma	/
7	Corixidae	HHT //
8	Dineutus	HHT III
1	Dineutus (adult)	/
6	Hydrophilidae (Tropisternus)	HHT /
8	Uvarus	HHT III
3	Dytiscidae (larvae)	III
14	Chaoborus	HHT HHT HHT IIII
1	HEXATOMA	/
2	Stenelmis	//
3	Cheumatopsyche	III
6	Simulium	HHT /
5	Chironominae	HHT
15	:TOTAL:	

Community Structure

	ABOVE	BELOW		ABOVE	BELOW
% Ephem.			% Odon.		
% Plecop.			% Cole.		
% Trichop.			% Crustacea		
% EPT					
% Chir.			# of Taxa:		
% Diptera			Biotic Score:		

Comments:

FIELD DATA SHEETS - BENTHIC INVERTEBRATES

Waterbody Name: UTC-1

Client: EDCo

Project no: 2042-06-070

Investigators: REM, JKH, JJF, JBB

Date Sample Collected: 4/20/06

Habitat Forms Completed: (yes) / no

Location: _____

Ecoregion: Gulf Coastal

Weather: cloud / treat of rain

Form Completed By: REM / JBB

Form Checked By: _____

Fish Sampling Completed: (yes) / no

Collection Site Observations		
	Above Station	Below Station
Total Area Sampled (%)	UTC-1	UT-B-2
Relative Abundance of Aquatic Flora		
Periphyton:	0 (1) 2 3 4	0 1 2 3 4
Filamentous Algae:	0 (1) 2 3 4	0 1 2 3 4
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4
Slimes:	0 (1) 2 3 4	0 1 2 3 4
Macroinvertebrates:	0 1 (2) 3 4	0 1 2 3 4
Fish:	0 (1) 2 3 4	0 1 2 3 4
Other_____:	0 1 2 3 4	0 1 2 3 4
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant		
Major Habitat Sampled (%)		
Riffle/Run:	10/10	
Shallow Pool:	90	
Deep Pool:		
Backwaters:		
Chanelized:		
Micro Habitats Sampled (%)		
Woody Debris:	40	
Emergent Vegatation:		
Submerged Vegetation:		
Depositional Area:	10	
Overhanging Veg:	30	
Root Wads:	10	
Undercut Banks:		
Filamentous algae:		
Leafy Debris:	15	
Other_____:		

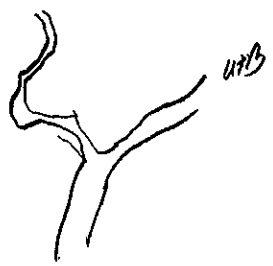
Macroinvertebrate Qualitative Sample List		
Taxa	Above Station	Below Station
Annelida		
Decapoda		
Gastropoda		
Pelecypoda		
Hemiptera		
Coleoptera		
Lepidoptera		
Odonata		
Megaloptera		
Diptera		
Chironomidae		
Plecoptera		
Ephemeroptera		
Trichoptera		
Amphipoda		

R=Rare, C=Common, A=Abundant, D=Dominant

Rare<3, Common 3-9, Abundant>10, Dominant>50

Site Description and Observations:

Sampled from mouth upstream to point of stream depletion, 2 primary pools offs of drops clay substrate



Rapid Bioassessment Field Sheet

Point Source _____ Date 4/20/2006

Collector Ren Sample Technique SMAM Sediment ? _____

Habitat Description: ABOVE _____ 2042-06-070

BELOW UTC-1 - unnamed tributary above UTB-

MACROINVERTEBRATE COMMUNITY

ABOVE Station # _____

Cnt.	Taxa	Tally

BELOW Station # UTC-1

Cnt.	Taxa	Tally
32	Amphipoda	
18	Isopoda	
5	Oligochaeta	
3	Cambarinae	(2 released)
4	Dytiscidae (larvae)	
5	Corixidae	
1	Lecane	
1	Dineutus (larvae)	
3	Elmidae	
1	Bittacomorpha	
2	Plexatheron	
7	elaborous	
7	Simuliidae	
5	Tanytarsini	
8	Culicidae	
4	Orthocladinae	

	:TOTAL:	

15 TAXA	:TOTAL:	104

Community Structure

	ABOVE	BELOW
% Ephem.		
% Plecop.		
% Trichop.		
% EPT		
% Chir.		
% Diptera		

	ABOVE	BELOW
% Odon.		
% Cole.		
% Crustacea		
# of Taxa:		
Biotic Score:		

Comments:

FIELD DATA SHEETS - FISH

Waterbody Name: Flat Creek
Client: EDCC
Project no: 2042-06-070
Investigators: REN, JBB, SKH, JJF
Date Sample Collected: 4/17/06
Habitat Forms Completed: (yes) / no

Location: FC-2, FC-1
Ecoregion: Gulf Coastal
Weather: Partly Cloudy - mostly Clear
Form Completed By: REN
Form Checked By:
Fish Sampling Completed: (yes) / no

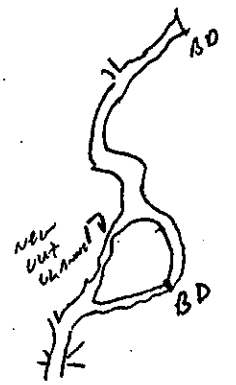
Collection Site Observations

	FC-1 Above Station	FC-2 Below Station	Additional Observations:
Total Time Sampled (s)			
Relative Abundance of Aquatic Biota			
Periphyton:	0 (1) 2 3 4	0 1 (2) 3 4	
Filamentous Algae:	(0) 1 2 3 4	(0) 1 2 3 4	
Macrophytes:	0 (1) 2 3 4	(0) 1 2 3 4	
Slimes:	(0) 1 2 3 4	(0) 1 2 3 4	
Macroinvertebrates:	0 1 (2) 3 4	0 1 2 3 4	
Fish:	0 (1) 2 3 4	0 (1) 2 3 4	
Other_____:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:	1.5/60 ~~10~~ Rare	10 (through woody debris)	
Shallow Pool:	~~10~~ 25	75	
Deep Pool:		15	
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:	90	75	FC-2: Habitat abundant Fish abundance less than expected
Emergent Vegatation:			
Submerged Vegetation:			
Depositional Area:		5	
Overhanging Veg:			
Root Wads:	5	15	
Undercut Banks:	5	5	
Filamentous algae:			
Leafy debris:			

Substrate Type and Scoring

Substrate	Score		Adj. Score
Bedrock:		X 0.1	
Lg. Boulder:		X 1.0	
Boulders:		X 1.0	
Rubble:		X 1.0	
Gravel:		X 1.0	
~~Sand~~: Clay-Hard pack	15	X 0.5	10
Mud/Silt: SAND Dominated		X 0.1	60
	~~10~~ 85	X 0.1	~~30~~

Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0



PID: 2619

FC-2 & FC-1

Sampling Gear Type: (Electrofishing) Seine Gill nets

Unit of Effort: Above: 2524 Below: 2619 PDT

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, (Sparse), Absent

Below Station: (Very Abundant), Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: wide shallow sand/silt dominant, little rootwad on undercut bank - shallow sandy runs.

Below Station: see sketch on previous page. Read from near RB upstream to second split.

Final LAB #'s are Circled

Fish Species Observed

Above Station #	Below Station # FC-2	FC-1 Above station
(22) Longear Sunfish	𝍸 𝍸 𝍸 𝍸 I	III +26 (35)
(4) Green 2 w/ external parasites	II	II (2) 1 w/ external parasites
(10) Spotted	𝍸 𝍸	I (1)
(3) Creek Chubsucker	II 1 released	II (2)
(4) Yellow Bullhead	IIII	IIII (4)
Ø Bluegill Green hybrid	I	
(1) Bluegill	II	II (1)
WARMOUTH		II (2) (1) Hybrid WARMOUT
Ø ~~Other~~ Grass Pickerel	III Released/Observed	
Redbreast (2) Redfin Shiner	𝍸 I	
(2) Blackspotted Topminnow	III — many observed - common	~~Common~~ (1) few observed
Creek chub		𝍸 III (8)
Gambusia		𝍸 𝍸 (15)
45 collected	(54) total	(72)

FIELD DATA SHEETS - FISH

Waterbody Name: UTA-1
Client: EDA
Project no: 2042-06-070
Investigators: RPM SKH JBB JJF
Date Sample Collected: 4/18/06

Location: UTA-1
Ecoregion: Gulf Coastal
Weather: Sunny, Hot

Form Completed By: JBB
Form Checked By:

Habitat Forms Completed: (yes) / no
Fish Sampling Completed: (yes) / no

Collection Site Observations			
	Above Station	Below Station	Additional Observations:
Total Time Sampled (s)			
Relative Abundance of Aquatic Biota			
Periphyton:	0 1 (2) 3 4	0 1 2 3 4	
Filamentous Algae:	0 1 (2) 3 4	0 1 2 3 4	
Macrophytes:	0 1 (2) 3 4	0 1 2 3 4	
Slimes:	(0) 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4	
Fish:	0 1 2 (3) 4	0 1 2 3 4	
Other:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:			
Shallow Pool:	20		
Deep Pool:	80		
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:	60		
Emergent Vegatation:			
Submerged Vegetation:			
Depositional Area:			
Overhanging Veg:			
Root Wads:	10		
Undercut Banks:	20		
Filamentous algae:			
Leafy debris:	10		
Substrate Type and Size			
Substrate	Score	Adj. Score	
Bedrock:	X 0.1		
Lg. Boulder:	X 1.0		
Boulders:	X 1.0		
Rubble:	X 1.0		
Gravel:	X 0.5		
Sand:	X 0.1		
Mud/Silt:	100 % X 0.1		
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

UTA-1

Sampling Gear Type: (Electrofishing) Seine Gill nets

Unit of Effort: Above: Below: 1605

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, (Abundant), Moderate, Sparse, Absent

Site Description & Notes:

Above Station:

Below Station: Deep pools from beaver, very little flow, extremely hard collections, deep pools dominated reach

Fish Species Observed

Above Station #	Below Station #	
Largemouth bass	III (3)	
Longear	////-////-////-////-////-/// (12)	1 external parasite
Green	(7)	
Bluegill	//// / (11)	
Warmouth	//// // (7)	1 external parasite
Spotted	//// / (13)	
Blackspotted Topminnow	//// /// (8)	
Pirate Perch	//// (4)	
Gambusia	//// //// (14)	
Spotted Sunfish	//// 16	
~~Notropis Species~~ / Redfin shiner	//// (5)	
~~Bass~~		
Grass pickerel	/ (1)	
Darter - Blunthose JJF 5/17/02	//// (4)	

Find #'s Lab checked at Cleveland

FIELD DATA SHEETS - FISH

Waterbody Name: UTA-2
Client: FDC
Project no: 2042-06-070
Investigators: REM, SKH, JBB, JDF
Date Sample Collected: 4/18/06
Habitat Forms Completed: (yes) / no

Location: UTA-R
Ecoregion: Gulf Coastal
Weather: Sunny, Hot
Form Completed By: JBB
Form Checked By:
Fish Sampling Completed: (yes) / no

Collection Site Observations

	Below Above Station	Below Station	Additional Observations:
Total Time Sampled:			
Relative Abundance of Aquatic Biota			
Periphyton:	(0) 1 2 3 4	0 1 2 3 4	
Filamentous Algae:	(0) 1 2 3 4	0 1 2 3 4	
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4	
Slimes:	(0) 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4	
Fish:	0 1 2 (3) 4	0 1 2 3 4	
Other_____:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:	10		
Shallow Pool:	80		
Deep Pool:	10		
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:	30		
Emergent Vegatation:			
Submerged Vegetation:			
Depositional Area:			
Overhanging Veg:	10		
Root Wads:	20		
Undercut Banks:	40		
Filamentous algae:			
Leafy debris:			

Substrate Type and Scoring

Substrate	Score		Adj. Score
~~Bedrock:~~ Hard Pan Clay	10%	X 0.1	
Lg. Boulder:		X 1.0	
Boulders:		X 1.0	
Rubble:		X 1.0	
Gravel:	10 %	X 0.5	
Sand:		X 0.1	
~~Mud/Silt:~~ Sand/Silt	80 %	X 0.1	
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

UTA - 2

Sampling Gear Type: (Electrofishing) Seine Gill nets

Unit of Effort: Above: ______ Below: 3477

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, (Moderate), Sparse, Absent

Site Description & Notes:

Above Station: ______

Below Station: ______

Fish Species Observed

Above Station #	Below Station #	
Longear Sunfish	𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸𝍸 1 (129 / 132)	(149)
Green " "	𝍸𝍸𝍸	(25)
Spotted " "	/	(13)
Grass Pickerel	//	(2)
Largemouth Bass	/	(1)
Flyer	//	(2)
Creek Chubsucker	////	(1)
Golden Shiner	𝍸𝍸	(10) 6 w/external parasite
Redfin Shiner	𝍸𝍸𝍸𝍸𝍸 /	(29)
Warmouth	𝍸 ///	(8)
Gambusia	𝍸𝍸𝍸𝍸𝍸 //	(40)
Bluegill	𝍸𝍸𝍸𝍸𝍸𝍸𝍸 /	(3)
Black spotted Topminnow	𝍸 ///	(9)
Cypress Darter	////	(3)
Blacktail Shiner → Notropis species 1 (black dorsal fin, wedge spot tail, mouth terminally oblique) ///		(1)
Yellow bullhead	/	(1)
Dollar Sunfish ?	/	
Notropis species 2 Pugnose minnow	//	(3)
Golden Topminnow	//	(1)
Creek Chub		(3)
Bluntnose darter		(1)

Revision 1.2 05/28/02
GBM[c] & Assoc. Doc. 1
Page 2 of 2

Final #s? Lab Check are Circled

FIELD DATA SHEETS - FISH

Waterbody Name: UTA-3
Client: EDC
Project no: 2042-06-070
Investigators: REM SKH JBB JJF
Date Sample Collected: 4/10/06
Habitat Forms Completed: (yes) / no

Location: UTA-3
Ecoregion: Gulf Coastal
Weather: Sunny
Form Completed By: JBB
Form Checked By:
Fish Sampling Completed: (yes) / no

Collection Site Observations			
	Above Station	Below Station	Additional Observations:
Fish Tag Sample #	7597		
Relative Abundance of Aquatic Biota			
Periphyton:	(0) 1 2 3 4	0 1 2 3 4	
Filamentous Algae:	(0) 1 2 3 4	0 1 2 3 4	
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4	
Slimes:	(0) 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4	
Fish:	0 1 2 (3) 4	0 1 2 3 4	
Other_____:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:	5%		
Shallow Pool:	80%		
Deep Pool:	15%		
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:	60%		
Emergent Vegatation:			
Submerged Vegetation:			
Depositional Area:			
Overhanging Veg:			
Root Wads:	30%		
Undercut Banks:	5%		
Filamentous algae:			
Leafy debris:	5%		
Substrate Type and Scoring			
Substrate	Score		Adj. Score
Bedrock:		X 0.1	
Lg. Boulder:		X 1.0	
Boulders:		X 1.0	
Rubble:		X 1.0	
Gravel:		X 0.5	
~~Sand:~~ Hard Pan Clay	30%	X 0.1	
Mud/Silt:	70%	X 0.1	
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

UTA-3

Sampling Gear Type: ~~Electrofishing~~ Seine Gill nets

Unit of Effort: Above: Below: 2597

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station:

Below Station:

Fish Species Observed

Above Station #	Below Station #	
Spotted	HHT /	8
Green	HHT /	9
Notropis Species / Blacktail Shiner	HHT ///	6
Yellow Bullhead	HHT	5
Creek Chubsucker	///	4
Warmouth	/	1
Golden Topminnow		
Blackspotted Topminnow	HHT	5
Longear	HHT HHT HHT HHT HHT HHT HHT HHT HHT	37
Notropis // Pugnose Minnow	///	2
Grass Pickerel	/	1
Gambusia	HHT HHT	10
Hemophayles notatis	/	
Notropis ///	//	
Redfin Shiner	HHT	11
Ethostoma Blunthose darter	/	1

Final #'s Lab Checked and Circled

FIELD DATA SHEETS - FISH

Waterbody Name: UTB-1
Client: EDC
Project no: 2042-06-070
Investigators: REM, JBB, SLH, JJF
Date Sample Collected: 4/20/06
Habitat Forms Completed: (yes) / no

Location: UTB-1
Ecoregion: Gulf Coastal
Weather: Partly Cloudy, Hot
Form Completed By: JBB
Form Checked By:
Fish Sampling Completed: (yes) / no

Collection Site Observations

	Above Station	Below Station	Additional Observations:
Total Time Sampled			
Relative Abundance of Attached Biota			
Periphyton:	0 (1) 2 3 4	0 1 2 3 4	
Filamentous Algae:	0 1 (2) 3 4	0 1 2 3 4	
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4	
Slimes:	(0) 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 (3 4)	0 1 2 3 4	
Fish:	0 1 (2) 3 4	0 1 2 3 4	
Other_____:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitats Sampled (%)			
Riffle/Run:	75%		
Shallow Pool:	25%		
Deep Pool:			
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:			
Emergent Vegatation:			
Submerged Vegetation:			
Depositional Area:	20		
Overhanging Veg:	15		
Root Wads:			
Undercut Banks:	10		
Filamentous algae:			
~~Leafy debris:~~ Sand Run	55		

Substrate Type and Scoring

Substrate	Score		Adj. Score
Bedrock:		X 0.1	
Lg. Boulder:		X 1.0	
Boulders:		X 1.0	
Rubble:		X 1.0	
Gravel:		X 0.5	
Sand:	70 %	X 0.1	
~~Mud/Silt:~~ Clay	10 %	X 0.1	
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

UTB-1

Sampling Gear Type: (Electrofishing) Seine Gill nets

Unit of Effort: Above: 727s Below:

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, (Sparse), Absent

Below Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: Narrow channel, dominated by sand, shallow pools at outside meander bends, 3 feet width, 6 in depth

Below Station:

Fish Species Observed

Above Station # UTB-1	Below Station #
Grass Pickerel	1 (1)
Creek Chubsucker	III (1)
Redfin Shiner	HHT HHT IIII (14)
Green Sunfish	III (3)
Blackspotted Topminnow	II (2)
Longear Sunfish	HHT I 5
Golden Topminnow	1 (1)
slough darter	II (2)
Spotted Sunfish	1 (1)
Bluegill	1 (1)
creek chub	(1)
Bluntnose darter	(1)

Fish #s 1 & 2 checked are crushed

FIELD DATA SHEETS - FISH

Waterbody Name: UTB-2
Client: EDCC
Project no: 2042-06-070
Investigators: REM SKH JOF JBB
Date Sample Collected: 4/20/06
Habitat Forms Completed: (yes) / no

Location: UTB-2
Ecoregion: Gulf Coastal
Weather: Partly Cloudy, Hot

Form Completed By: SKH
Form Checked By:
Fish Sampling Completed: (yes) / no

Collection Site Observations

	UTB-2 Above Station	Below Station	Additional Observations:
Relative Abundance of Aquatic Biota			
Periphyton:	0 (1) 2 3 4	0 1 2 3 4	
Filamentous Algae:	(0) 1 2 3 4	0 1 2 3 4	
Macrophytes:	0 1 2 3 4	0 1 2 3 4	
Slimes:	0 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 3 4	0 1 2 3 4	
Fish:	0 1 2 3 4	0 1 2 3 4	
Other ____:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitat Sampled (%)			
Riffle/Run:	60 %		
Shallow Pool:	40 %		
Deep Pool:			
Backwaters:			
Chanelized:			
Microhabitats Sampled (%)			
Woody debris:	20		
Emergent Vegatation:	5		
Submerged Vegetation:			
Depositional Area:	10		
Overhanging Veg:	10		
Root Wads:	10		
Undercut Banks:	15		
~~Filamentous algae:~~ Sand Run	20		
Leafy debris:	10		

Substrate	Score	Adj. Score
Substrate Type and Scoring		
Bedrock:	X 0.1	
Lg. Boulder:	X 1.0	
Boulders:	X 1.0	
Rubble:	X 1.0	
Gravel:	X 0.5	
Sand:	90 X 0.1	
~~Mud/Silt:~~ clay	10 X 0.1	
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0		

Sampling Gear Type: (Electrofishing) Seine Gill nets

Unit of Effort: Above: Below:

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Below Station: Very Abundant, Abundant, Moderate, (Sparse) Absent

Site Description & Notes:

Above Station:

Below Station: UTB-2

Fish Species Observed

Above Station #	Below Station # UTB-2	
	Green Sunfish 1HH 11 - released 1	10 + 1 released (11)
	Black Bullhead - 1	(1)
	Longear - 25	(22)
	Creek Chub - 5	(4)
	Gambusia - 3	(3)
	Grass Pickerel - 5	(5)
	Red Fin Shiner - 29	(27)
	Golden Shiner - 9	(9) 3 internal parasites
	Walkmouth - 1	(1)
	Creek Chub Sucker - HH HH 1	(2)
	Notropis Spp. 1 - 2 pugnose minnow	(4)
		(99)

Final ID's by Lab Chemist are Circled

FIELD DATA SHEETS - FISH

Waterbody Name: UTC-1
Client: EDCC
Project no: 2042-06-070
Investigators: REM SKH JBB JJF
Date Sample Collected: 4/20/06
Habitat Forms Completed: (yes) / no

Location: UTC-1
Ecoregion: Gulf Coastal
Weather: Partly Cloudy, Hot
Form Completed By: JBB
Form Checked By:
Fish Sampling Completed: (yes) / no

Collection Site Observations

	Above Station	Below Station	Additional Observations:
Total Time Sampled:			
Relative Abundance of Aquatic Flora and Fauna			
Periphyton:	(0) 1 2 3 4	0 1 2 3 4	
Filamentous Algae:	0 (1) 2 3 4	0 1 2 3 4	
Macrophytes:	0 (1) 2 3 4	0 1 2 3 4	
Slimes:	(0) 1 2 3 4	0 1 2 3 4	
Macroinvertebrates:	0 1 2 (3) (4)	0 1 2 3 4	
Fish:	0 1 (2) 3 4	0 1 2 3 4	
Other_____:	0 1 2 3 4	0 1 2 3 4	
0=Not Observed, 1=Rare, 2=Common, 3=Abundant, 4=Dominant			
Major Habitats Sampled (%)			
Riffle/Run:	5		
Shallow Pool:	90		
Deep Pool:	5		
Backwaters:			
Chanelized:			
Micro-habitats Sampled (%)			
Woody debris:	5		
Emergent Vegatation:			
Submerged Vegetation:			
Depositional Area:	75		
Overhanging Veg:			
Root Wads:	5		
Undercut Banks:	~~20~~ 15		
Filamentous algae:			
Leafy debris:			

Substrate	Score		Adj. Score
Substrate Type and Scoring			
Bedrock:		X 0.1	
Lg. Boulder:		X 1.0	
Boulders:		X 1.0	
Rubble:		X 1.0	
Gravel:	5 %	X 0.5	
Sand:	85 %	X 0.1	
~~Mud/Silt:~~ clay	10 %	X 0.1	
Score: Abundant 11-15, Common 6-10, Sparce 1-5, Absent 0			

UTC-1

Sampling Gear Type: (Electrofishing) Seine Gill nets

Unit of Effort: Above: 607 Below:

Quantity of Available Fish Cover:

Above Station: Very Abundant, Abundant, Moderate, (Sparse), Absent

Below Station: Very Abundant, Abundant, Moderate, Sparse, Absent

Site Description & Notes:

Above Station: No flow, stained water, shallow pools, most fish within 100 yds of confluence, very shallow pools upstream, no fish

Below Station:

Fish Species Observed

Above Station #	Below Station #	
Longear	𝍸 𝍸 𝍸 𝍸 II	(16)
Green	I	(5)
Creek chubsucker	IIII	(1)
Redfin shiner	I	(1)
Bass sp	I	(1)
Pirate Perch	𝍸	(5)
Redfin shiner	𝍸 𝍸 I	(11)
Golden Topminnow	𝍸 I	(1)
Black spotted Topminnow	𝍸	(4)
Gambusia	𝍸 𝍸 IIII	(14)
creek chub		(2)

Find #'s Lab Checked on e-mail

Discharge/Flow Measurement Form

Station: UTC-1		
Waterbody:		
Date: 4/20/04		
Crew:	Start Time: 1025	Recorder: SKM
	End Time: 1030	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width: 3.5	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

(Wading), Boat, Upstream, Downstream, Side Bridge _____ ft/mi,

above, below gage, and _____

Measurement rated: excellent good (fair) poor based on the following conditions: Cross section _____

Flow _____ Weather _____

Other _____ Air _____ °F @ _____

Gage _____ Water _____ °F @ _____

Observer _____

Control _____

Remarks _____

(1) Distance from initial point RB	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, (0.6), or 0.8)	(5) Area (A)	(6) Discharge (Q)
0.5	0.5	0.2		ND			
1.0	0.5	0.3		0.05			
1.5	0.5	0.3		ND			
2.0	0.5	0.2		0.02			
2.5	0.5	0.2		0.02			
3.0	0.5	0.2		ND			
3.5	0.5	0.1		ND			
TOTALS							

Completed By_____ Checked by_____ Reviewed by_____

V1.0 1096

		date	4/20/2006	Start	1025
				Stop	1030
Station:	UTC1				
Waterbody					
Crew:	REM/SKH/JBB/JJF				
Width (ft):	3.5	Area:	0.8	Max Vel:	0.05
Flow (cfs):	0.01	Velocity:	0.01	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
0.5	0.5	0.2	0	0.1	0
1.0	0.5	0.3	0.05	0.15	0.0075
1.5	0.5	0.3	0	0.15	0
2.0	0.5	0.2	0.02	0.1	0.002
2.5	0.5	0.2	0.02	0.1	0.002
3.0	0.5	0.2	0	0.1	0
3.5	0.5	0.1	0	0.05	0
Total	3.50	1.90	0.09	0.75	0.01
Average	0.50	0.21	0.01	0.10	0.00

Discharge/Flow Measurement Form

Station: UTB-1		
Waterbody:		
Date: 4/20/06		
Crew: SKH/DTBB	Start Time: 1030	Recorder:
	End Time: 1040	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width:	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

Wading, Boat, Upstream, Downstream, Side Bridge _____ ft/mi,

above, below gage, and _____

Measurement rated: excellent good fair poor based on the following conditions: Cross section _____

Flow_____ Weather_____

Other_____ Air _____ °F @ _____

Gage_____ Water_____ °F @ _____

Observer _____

Control _____

Remarks _____

(1) Distance from initial point LB	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
0.5	0.5	0.3		0.68			
1.0		0.3		0.73			
1.5		0.3		0.76			
2.0		0.3		0.67			
2.5		0.3		0.86			
3.0		0.4		0.84			
4.0	1.0	0.4		1.07			
5.0	1.0	0.5		1.04			
5.5	0.5	0.5		0.99			
6.0		0.4		0.68			
6.5		0.2		0.45			
7.0		0.0		ND			
TOTALS							

V1.0 1096

Completed By_____ Checked by_____ Reviewed by_____

		date	4/20/2006	Start	1030
				Stop	1040
Station:	UTB1				
Waterbody					
Crew:	REM/SKH/JBB/JJF				
Width (ft):	7.0	Area:	2.4	Max Vel:	1.07
Flow (cfs):	2.10	Velocity:	0.73	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Avg Velocity at 2 point (ft/sec)	Area (sq ft)	Discharge (cfs)
0.5	0.5	0.3	0.68	0.15	0.102
1.0	0.5	0.3	0.73	0.15	0.1095
1.5	0.5	0.3	0.76	0.15	0.114
2.0	0.5	0.3	0.67	0.15	0.1005
2.5	0.5	0.3	0.86	0.15	0.129
3.0	0.5	0.4	0.84	0.2	0.168
4.0	1.0	0.4	1.07	0.4	0.428
5.0	1.0	0.5	1.04	0.5	0.52
5.5	0.5	0.5	0.99	0.25	0.2475
6.0	0.5	0.4	0.68	0.2	0.136
6.5	0.5	0.2	0.45	0.1	0.045
7.0	0.5	0	0	0	0
Total	7.00	3.90	8.57	2.40	2.10
Average	0.58	0.50	0.73	0.20	0.17

Discharge/Flow Measurement Form

Station: UTB-2		
Waterbody: unnamed		
Date: 4/20/06		
Crew: SKH/DBB	Start Time: 1010	Recorder: SKH
	End Time: 1020	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width: 6.5	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

(Wading), Boat, Upstream, Downstream, Side Bridge _____ ft/mi,

above, below gage, and _____

Measurement rated: excellent (good) fair poor based on the following

conditions: Cross section _____

Flow _____ Weather _____

Other _____ Air _____ °F @ _____

Gage _____ Water _____ °F @ _____

Observer _____

Control _____

Remarks _____

(1) Distance from initial point RB	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, (0.6) or 0.8)	(5) Area (A)	(6) Discharge (Q)
0.5	0.5	0.2		0.11			
1.0		0.5		0.83			
1.5		0.5		0.46			
2.0		0.6		0.60			
2.5		0.7		0.65			
3.0		0.7		0.90			
3.5		0.7		0.72			
4.0		0.7		0.83			
4.5		0.5		0.45			
5.0		0.4		0.46			
5.5		0.4		0.28			
6.0		0.2		0.13			
6.5	—	0.0		ND			
TOTALS							

Completed By_____ Checked by_____ Reviewed by_____

		date	4/20/2006	Start	1010
				Stop	1020
Station:	UTB2				
Waterbody					
Crew:	REM/SKH/JBB/JJF				
Width (ft):	6.5	Area:	3.1	Max Vel:	0.9
Flow (cfs):	1.87	Velocity:	0.49	Min Vel:	0

Distance from initial point (ft) (I)	Width (ft) (W)	Depth (ft) (D)	Velocity at point (ft/sec)	Area (sq. ft)	Discharge (cfs)
0.5	0.5	0.2	0.11	0.1	0.011
1.0	0.5	0.5	0.83	0.25	0.2075
1.5	0.5	0.5	0.46	0.25	0.115
2.0	0.5	0.6	0.6	0.3	0.18
2.5	0.5	0.7	0.65	0.35	0.2275
3.0	0.5	0.7	0.9	0.35	0.315
3.5	0.5	0.7	0.72	0.35	0.252
4.0	0.5	0.7	0.83	0.35	0.2905
4.5	0.5	0.5	0.45	0.25	0.1125
5.0	0.5	0.4	0.46	0.2	0.092
5.5	0.5	0.4	0.28	0.2	0.056
6.0	0.5	0.2	0.13	0.1	0.013
6.5	0.5	0	0	0	0
Total:	6.50	6.10	6.42	3.05	1.87
Average:	0.50	0.47	0.49	0.23	0.14

Discharge/Flow Measurement Form

Station: UTA - 1		
Waterbody: Unnamed trib to Flat Creek		
Date: 4/18/06		
Crew: CKH/RFw	Start Time: —	Recorder:
	End Time: —	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width:	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

Wading, Boat, Upstream, Downstream, Side Bridge _____ ft/mi,

above, below gage, and _____

Measurement rated: excellent good fair poor based on the following conditions: Cross section _____

Flow_____ Weather_____

Other_____ Air _____°F @ _____

Gage_____ Water_____°F @ _____

Observer _____

_____

Control _____

_____

Remarks _____

_____

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
TOTALS							

Flow #1

Completed By_____ Checked by_____ Reviewed by_____

Pool Flow ND date 4/18/2006 Start

Stop

Station: UTA1			
Waterbody			
Crew: REM/SKH/JBB/JJF			
Width (ft):	Area: 0.0	Max Vel:	0
Flow (cfs): 0.00	Velocity: #DIV/0!	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Ave Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
				0	0
				0	0
				0	0
				0	0
				0	0
Total	0.00	0.00	0.00	0.00	0.00
Average	#DIV/0!	#DIV/0!	#DIV/0!	0.00	0.00

Discharge/Flow Measurement Form

Station: UTA-2		
Waterbody: unnamed Trib		
Date: 4/18/06		
Crew:	Start Time: 1105	Recorder: SRH
	End Time:	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width: 10'	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

Wading, Boat, Upstream, Downstream, Side Bridge _____ ft/mi,

above, below gage, and _____

Measurement rated: excellent good fair poor based on the following

conditions: Cross section _____

Flow _____ Weather _____

Other _____ Air _____ °F @ _____

Gage _____ Water _____ °F @ _____

Observer _____

Control _____

Remarks _____

(1) Distance from initial point RB	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
1.0	1.0	0.4		0.33			
2.0		0.5		0.66			
3.0		0.6		0.78			
4.0		0.7		0.98			
5.0		0.7		1.06			
6.0		0.7		1.09			
7.0		0.7		0.85			
8.0		0.3		0.57			
9.0		0.6		ND			
10.0		0.0		ND			
TOTALS							

Completed By_____ Checked by_____ Reviewed by_____

V1.0 1096

		date	4/18/2006	Start	1105
				Stop	1115
Station:	UTA2				
Waterbody					
Crew:	REM/SKH/JBB/JJF				
Width (ft):	10.0	Area:	5.7	Max Vel:	1.09
Flow (cfs):	4.14	Velocity:	0.63	Min Vel:	0

Station (ft)	Width (ft)	Depth (ft)	Velocity (ft/sec)	Area (sq ft)	Discharge (cfs)
1.0	1.0	0.4	0.33	0.4	0.132
2.0	1.0	0.5	0.66	0.5	0.33
3.0	1.0	0.6	0.78	0.6	0.468
4.0	1.0	0.7	0.98	0.7	0.686
5.0	1.0	0.7	1.06	0.7	0.742
6.0	1.0	0.7	1.09	0.7	0.763
7.0	1.0	0.7	0.85	0.7	0.595
8.0	1.0	0.8	0.53	0.8	0.424
9.0	1.0	0.6	0	0.6	0
10.0	1.0	0	0	0	0
total	10.00	5.70	6.28	5.70	4.14
average	1.00	0.57	0.63	0.57	0.41

Discharge/Flow Measurement Form

Station: UNT-3		
Waterbody: Unnamed Trib		
Date: 4/19/04		
Crew: SKH/OUF	Start Time: 1240	Recorder: SKH
	End Time: 1245	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width: 10.5	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

(Wading) Boat, Upstream, Downstream, Side Bridge _____ ft/mi,

above, below gage, and _____

Measurement rated: excellent (good) fair poor based on the following

conditions: Cross section _____

Flow _____ Weather _____

Other _____ Air _____ °F @ _____

Gage _____ Water _____ °F @ _____

Observer _____

Control _____

Remarks _____

(1) Distance from initial point 48	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, (0.6) or 0.8)	(5) Area (A)	(6) Discharge (Q)
1.0	1.0	1.0		0.16			
2.0	1.0	1.0		0.46			
3.0	1.0	1.0		0.49			
4.0		1.0		0.50			
5.0		1.1		0.43			
6.0		1.1		0.40			
7.0		1.0		0.38			
8.0		0.7		0.40			
9.0		0.6		0.33			
10.0	1.0	0.3		0.16			
10.5	0.5	0.0		ND			
TOTALS							

Completed By_____ Checked by_____ Reviewed by_____

		date	4/17/2006	Start	1740
				Stop	1745
Station:	UTA3				
Waterbody					
Crew:	REM/SKH/JBB/JJF				
Width (ft):	10.5	Area:	8.9	Max Vel:	0.5
Flow (cfs):	3.47	Velocity:	0.34	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Velocity at point (ft/sec)	Area (sq. ft)	Discharge (cfs)
1.0	1.0	1	0.16	1	0.16
2.0	1.0	1	0.46	1	0.46
3.0	1.0	1	0.49	1	0.49
4.0	1.0	1	0.5	1	0.5
5.0	1.0	1.1	0.43	1.1	0.473
6.0	1.0	1.1	0.4	1.1	0.44
7.0	1.0	1	0.38	1	0.38
8.0	1.0	0.8	0.4	0.8	0.32
9.0	1.0	0.6	0.33	0.6	0.198
10.0	1.0	0.3	0.16	0.3	0.048
10.5	0.5	0	0	0	0
Total	10.50	9.90	3.91	8.90	3.47
Average	0.95	0.81	0.31	0.81	0.3

Discharge/Flow Measurement Form

Station: FC-1		
Waterbody: Flat Creek		
Date: 4/19/06		
Crew: JF/RCM	Start Time: 1036	Recorder: JF
	End Time:	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width: 14	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:
Wading, Boat, Upstream, Downstream, Side Bridge 75ft ft/mi,
above, below gage, and _____

Measurement rated: excellent good fair poor based on the following conditions: Cross section _____
Flow_____ Weather_____
Other_____ Air _____ °F @ _____
Gage_____ Water_____ °F @ _____

Observer JJF/RCM

Control _____

Remarks _____

(1) Distance from initial point	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
RDB 0	0	0.0		NP			
2	2	0.5		NP			
3	1	0.6		0.07			
4	1	0.7		0.11			
5	1	0.8		0.15			
6	1	0.9		0.24			
7	1	0.9		0.41			
8	1	0.7		0.41			
9	1	0.6		0.33			
10	1	0.6		0.21			
11	1	0.5		0.24			
12	1	0.3		0.05			
13	1	0.2		ND			
RDB 15	2	0.2		ND			
TOTALS							

V1.0 1096

Completed By RCM Checked by_____ Reviewed by_____

		date	4/19/2006	Start	1036
				Stop	1046
Station:	FC1				
Waterbody					
Crew:	REM/SKH/JBB/JJF				
Width (ft):	14.0	Area:	8.2	Max Vel:	0.41
Flow (cfs):	1.57	Velocity:	0.16	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Velocity at point (ft/sec)	Area (sq ft)	Discharge (cfs)
0.0	0.0	0	0	0	0
2.0	2.0	0.5	0	1	0
3.0	1.0	0.6	0.07	0.6	0.042
4.0	1.0	0.7	0.11	0.7	0.077
5.0	1.0	0.8	0.15	0.8	0.12
6.0	1.0	0.9	0.24	0.9	0.216
7.0	1.0	0.9	0.41	0.9	0.369
8.0	1.0	0.7	0.41	0.7	0.287
9.0	1.0	0.6	0.33	0.6	0.198
10.0	1.0	0.6	0.21	0.6	0.126
11.0	1.0	0.5	0.24	0.5	0.12
12.0	1.0	0.3	0.05	0.3	0.015
13.0	1.0	0.2	0	0.2	0
15.0	2.0	0.2	0	0.4	0
Total	15.00	7.50	2.22	8.20	1.57
Average	1.07	0.54	0.16	0.59	0.11

Discharge/Flow Measurement Form

Station: AC-2		
Waterbody: Elk CREEK		
Date: 4/17/06 (1255)		
Crew:	Start Time: 1255	Recorder: SFH
	End Time:	GH. Change: _____ in
	Staff/Gage:	_____ hrs.
Width: 20.0	Area:	Velocity:
Disch/Flow:	Method:	No Secs:
Meter No:	Max Vel:	Min Vel:

ORIENTATION:

(Wading) Boat, Upstream, Downstream, Side Bridge _____ ft/mi,

above, below gage, and _____

Measurement rated: excellent good (fair) poor based on the following

conditions: Cross section _____

Flow_____ Weather_____

Other_____ Air _____°F @ _____

Gage_____ Water_____°F @ _____

Observer _____

Control _____

Remarks _____

(1) Distance from initial point RB	(2) Width (W)	(3) Depth (D)	Obstruction(s) (logs, rocks, other)	(4) Avg. Velocity At Point (V)	Method Depth (0.2, 0.6, or 0.8)	(5) Area (A)	(6) Discharge (Q)
2.0	2.0	0.6	logs	ND			
4.0	|	0.6	stick	0.22			
6	|	0.8	|	0.23			
8	|	0.4	|	0.43			
10	|	0.3	|	0.16			
12	|	0.6	|	0.03			
14	|	1.0	|	0.08			
16	|	1.2	|	0.05			
18	|	1.0	|	0.04			
20	⊥	1.0		ND			
TOTALS							

Completed By_____ Checked by_____ Reviewed by_____

		date	4/17/2006	Start	1255
				Stop	1305
Station:	FC2				
Waterbody					
Crew:	REM/SKH/JBB/JJF				
Width (ft):	20.0	Area:	15.0	Max Vel:	0.43
Flow (cfs):	1.47	Velocity:	0.12	Min Vel:	0

Distance from initial point (ft)	Width (ft)	Depth (ft)	Velocity at point (ft/sec)	Area (Sq ft)	Discharge (cfs)
2.0	2.0	0.6	0	1.2	0
4.0	2.0	0.6	0.22	1.2	0.264
6.0	2.0	0.8	0.23	1.6	0.368
8.0	2.0	0.4	0.43	0.8	0.344
10.0	2.0	0.3	0.16	0.6	0.096
12.0	2.0	0.6	0.03	1.2	0.036
14.0	2.0	1	0.08	2	0.16
16.0	2.0	1.2	0.05	2.4	0.12
18.0	2.0	1	0.04	2	0.08
20.0	2.0	1	0	2	0
Total	20.00	7.50	1.24	15.00	1.47
Average	2.00	0.75	0.12	1.50	0.15

Field Data Form

FIELD MEASUREMENT RECORD (Date 4/17/06 1240) **REVIEWED BY:**_____

Station/Depth	Date	Time	Field Crew	Temp C°	DO mg/l	Sp. Cond. uS	pH su	Turb. (ntu)	Sample # of Containers S=Sed.	W=Wat.	Notes
* FC-2	4/17/06	1240	SKH JJF	23.0	5.5 mg/L	2771 (63.9% Sat.)	6.80	4.0	—	1	SO_4, Cl^-, TDS, NO_3
UTA-3	4/17/06	1400	JJF JBB	25.0	7.03	520	6.97	23	—	1	
UTA-2	4/18/06	0825	SKH	22.4	4.97 / 59.7%	522	6.94	~~19.7~~	—	1	
UTA-1	4/18/06	0850	SKH	22.3	~~1.75~~ 1.8 / 19.5%	158	6.53	11.2	—	1	
FC-1	4/19/06	0745	JJF JBB	23.6°	5.77 / 68.0%	2192	6.06	5.14	—	1	
UTB-2	4/19/06	1150	SKH / JBB	23.2	7.4 / 86.6%	782	7.19	13.8	—	1	
UTC-1	4/19/06	1215	SKH / JBB	22.0	4.1 / 47.4%	350	6.92	30.3	—	1	
UTB-1	4/19/06	1220	SKH / JBB	23.1	7.4 / 87.5%	787	7.45	11.7	—	1	
UTB-2	4/20/06	0830	SKH / JBB	22.3	6.64 / 73.9%	779	7.42	~~13~~ 14.1	—	1	
UTC-1	4/20/06	0945	~~JJF~~	21.4	3.67 / 40.2%	380.5	6.99	27.3	—	1	
UTB-1	4/20/06	1015		23.3	6.85 / 79.4	741	7.32	14.8	—	1	

* Indicates calibration check was made

Field Data Form

FIELD MEASUREMENT RECORD (Date 4/20/06) **REVIEWED BY:**_____

Station/Depth	Date	Time	Field Crew	Temp C°	DO mg/l	Sp. Cond. uS	pH su	Turb. (ntu)	Sample # of Containers Sed./Soil	Sample # of Containers Water	Notes
UTA-1	4/20/06	1355	SKH/JJB JSF/REM	24.3	4.40mg/L 58%	197.8	6.70	13.7	—	1	TDS, Cl^-, SO_4, NO_3
UTA-2	4/20/06	1415	"	24.5	6.16 ~~41~~%	602	7.01	18.0	—	1	"
UTA-3	4/20/06	1430	"	25.1	~~6.60~~ ~~40~~%	515	7.07	25.7	—	1	"
FC-2	4/20/06	1445	"	24.2	4.7 56.9%	1724	6.8	6.26	—	1	"
FC-1	4/20/06	1500	"	25.4	6.75 81.3%	2323	6.69	3.96 ~~6.69~~	—	1	"

* Indicates calibration check was made

Field Data Form

FIELD MEASUREMENT RECORD (Date 5/31/00) **REVIEWED BY:_____**

Station/Depth	Date	Time	Field Crew	Temp C°	DO mg/l	Sp. Cond. uS	pH su	Turb. (ntu)	Sample # of Containers Sed./Soil	Sample # of Containers Water	Notes
FC-2	5/31/00	0915	REM/JBS	23.5	5.74	1264	7.13	11.5	—	1	
UTA-3	5/31	0955	REM/JBS	24.1	4.99	186.4	7.32	16.8	—	1	
UTA-2	5/31/00	1030	REM/JBS	23.8	6.40	215.3	7.30	33.5	—	1	
UTB-2		1105	REM/JBS	23.3	7.64	346.0	7.26	14.2	—	1	
UTB-1		1110		23.2	8.51	327.6	7.30	10.6	—	1	
UTC-1		1115		22.7	4.81	249.3	7.37	80.6	—	1	
FC-1		1210		23.8	5.80	2233	6.53 ~~7.44~~	24.4	—	1	
UTA-1		1240		23.6	3.74	420.6	6.56	56.1	—	1	

* Indicates calibration check was made

EDCC 4G - Instream Minerals Data

UTA-1			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/17/06	24.4	3.00	124
4/20/06	35.7	3.06	153
5/31/2006	115	5.54	300
Average			

UTC-1			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/19/06	13.2	32.1	258
4/20/06	13.2	34.0	304
5/31/2006	13	29.2	206
Average			

UTA-2			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/17/06	31.0	44.5	362
4/20/06	32.7	52.0	406
5/31/2006	26.9	11.1	142
Average			

UTB-1			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/19/06	37.9	73.2	560
4/20/06	38.1	74.4	524
5/31/2006	18.7	49.5	178
Average			

UTA-3			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/17/06	27.2	41.5	358
4/20/06	29.9	45.0	372
5/31/2006	19.8	11.7	130
Average			

UTB-2			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/19/06	39.9	75.4	492
4/20/06	38.6	74.4	512
5/31/2006	19.6	51.8	206
Average			

FC-1			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/19/06	568	64.4	1160
4/20/06	629	64.8	1410
4/20/06 (dup)	553	62	1370
5/31/2006	689	5.9	1200
Average			

FC-2			
Date	Cl^- (mg/L)	SO_4 (mg/L)	TDS (mg/L)
4/17/06	777	24.0	1740
4/20/06	497	56.3	1100
5/31/2006	375	15.8	710
Average			

ECOREGION NUMBERS (Cl, SO4, &TDS): 14 mg/L, 31 mg/L, & 123 mg/L

Ana-Lab Corporate Laboratory P.O. Box 9000 Kilgore, TX 75663
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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

821581 FC-2 *Received:* 04/18/2006

Liquid Aqueous *Collected by:* Client *Affiliation:* GBMc & Associates 04/17/2006 1235

EPA 160.1			*Analyzed: CLH*	*04/20/2006*	*0930*	*QCgroup*	*179517*	
Total Dissolved Solids	**1740**	**mg/L**	50			01		
EPA 300.0			*Analyzed: GDG*	*04/19/2006*	*1003*	*QCgroup*	*179611*	
Sulfate	**24.0**	**mg/L**	3.00			01		
EPA Method 300.0			*Analyzed: GDG*	*04/19/2006*	*1003*	*QCgroup*	*179611*	
Nitrate-Nitrogen, Total	**0.371**	**mg/L**	0.100			01		
EPA Method 300.0			*Analyzed: GDG*	*04/19/2006*	*1343*	*QCgroup*	*179611*	
Chloride	**777**	**mg/L**	150			01		

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

821582 UTA-3 *Received:* 04/18/2006

Liquid Aqueous *Collected by:* Client *Affiliation:* GBMc & Associates 04/17/2006 1405

EPA 160.1			*Analyzed: CLH*	*04/20/2006*	*0930*	*QCgroup*	*179517*	
Total Dissolved Solids	**358**	**mg/L**	10			01		
EPA 300.0			*Analyzed: GDG*	*04/19/2006*	*1023*	*QCgroup*	*179611*	
Sulfate	**41.5**	**mg/L**	3.00			01		
EPA Method 300.0			*Analyzed: GDG*	*04/19/2006*	*1023*	*QCgroup*	*179611*	
Chloride	**27.2**	**mg/L**	3.00			01		
Nitrate-Nitrogen, Total	**24.1**	**mg/L**	0.100			01		

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

821583 UTA-2 *Received:* 04/18/2006

Liquid Aqueous *Collected by:* Client *Affiliation:* GBMc & Associates 04/18/2006 0825

EPA 160.1			*Analyzed: CLH*	*04/20/2006*	*0930*	*QCgroup*	*179517*	
Total Dissolved Solids	**362**	**mg/L**	10			01		
EPA 300.0			*Analyzed: GDG*	*04/19/2006*	*1043*	*QCgroup*	*179611*	
Sulfate	**44.5**	**mg/L**	3.00			01		
EPA Method 300.0			*Analyzed: GDG*	*04/19/2006*	*1043*	*QCgroup*	*179611*	
Chloride	**31.0**	**mg/L**	3.00			01		
Nitrate-Nitrogen, Total	**23.4**	**mg/L**	0.100			01		

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

821584 UTA-1 *Received:* 04/18/2006

Liquid Aqueous *Collected by:* Client *Affiliation:* GBMc & Associates 04/18/2006 0850

EPA 160.1			*Analyzed:*	*CLH*	*04/20/2006*	*0930*	*QCgroup*	*179517*
Total Dissolved Solids	**124**	**mg/L**	5				01	
EPA 300.0			*Analyzed:*	*GDG*	*04/19/2006*	*1103*	*QCgroup*	*179611*
Sulfate	**ND**	**mg/L**	3.00				01	
EPA Method 300.0			*Analyzed:*	*GDG*	*04/19/2006*	*1103*	*QCgroup*	*179611*
Chloride	**24.4**	**mg/L**	3.00				01	
Nitrate-Nitrogen, Total	**0.122**	**mg/L**	0.100				01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

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Project [redacted]

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Qualifiers:

E - Estimated Value
B - Analyte detected in the associated method blank
! - Lab MDL > Target
J - Analyte detected below quantitation limit
S - Standard reads lower than desired
- ND in the results column is not detected above SQL

Unless otherwise noted, testing was performed at Ana-lab's corporate laboratory that holds the following Federal and State certificates: Texas Department of Health Lead Firm Certificate 2110076, EPA National Lead Laboratory Accreditation Program #637.01, Texas Department of Agriculture Soil Import Permit S-37592, Texas Department of Health Drinking Water Laboratory Certificate TX219, Oklahoma Department of Environmental Quality Drinking Water Certification Lab ID# D9913, EPA Lab Number TX00063, USEPA Approved Perchlorate Testing Lab, Oklahoma Department of Environmental Quality Laboratory Certificate 8125, Arkansas Department of Environmental Quality Certification #03-070-0, Louisiana Department of Environmental Quality Laboratory Certification (NELAP, LELAP) #02008, Louisiana Department of Health and Hospitals Drinking Water (NELAP) # LA030020, Delaware Health and Social Services (ODW) Drinking Water Approved, US Department of Energy Approved, Entidad Mexicana de Acreditacion, A.C. (EMA, in renewal as of 6/18/2004) Agua Ag-014-003/03 and Fuentes Fijas, Residuos y Ambiente Laroral FRA-013-005/03, State of Kansas Department of Health and Environment Waste Water and Solid/Hazardous Waste Cert. E-10365, Alabama Department of Environmental Management Drinking Water #41540. Ana-Lab is also accredited to the international ISO-17025 standard by the American Association for Laboratory Accreditation (A2LA Certificate # 0637-01).

These analytical results relate to the sample tested. This report may NOT be reproduced EXCEPT in FULL without written approval of Ana-Lab Corp. Unless otherwise specified, these test results meet the requirements of NELAC.
RL is the Reporting Limit (sample specific quantitation limit) and is at or above the Method Detection Limit (MDL). CAS is Chemical Abstract Service number.

Roy White

Roy White, MS, Quality Manager

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

179611 **O** **Liquid Aqueous** **EPA Method 300.0**

Blank

Parameter	*PrepSet*	*Reading*	*MDL*	*MQL*	*Units*	*Out*	*File*
Bromide	179611	ND	3.91	50.0	ug/L		0002640228
Chloride	179611	ND	53.4	300	ug/L		0002640228
Fluoride	179611	ND	2.28	100	ug/L		0002640228
Nitrate-Nitrite Nitrogen	179611	ND	3.21	20.0	ug/L		0002640228
Nitrate-Nitrogen, Total	179611	ND	2.35	10.0	ug/L		0002640228
Nitrite-Nitrogen, Total	179611	ND	1.76	10.0	ug/L		0002640228
Ortho - Phosphate as P	179611	ND	6.47	10.0	ug/L		0002640228
Sulfate	179611	ND	55.3	300	ug/L		0002640228

CCV

Parameter	*Reading*	*Known*	*Units*	*Recover%*	*Limits%*	*Out*	*File*
Bromide	9830	10000	ug/L	98.3	90.0 - 110		0002640254
Bromide	9890	10000	ug/L	98.9	90.0 - 110		0002640243
Bromide	9910	10000	ug/L	99.1	90.0 - 110		0002640225
Chloride	10300	10000	ug/L	103	90.0 - 110		0002640254
Chloride	9800	10000	ug/L	98.0	90.0 - 110		0002640225
Chloride	9850	10000	ug/L	98.5	90.0 - 110		0002640243
Fluoride	9570	10000	ug/L	95.7	90.0 - 110		0002640254
Fluoride	9680	10000	ug/L	96.8	90.0 - 110		0002640243
Fluoride	9700	10000	ug/L	97.0	90.0 - 110		0002640225
Nitrate-Nitrite Nitrogen	5170	5300	ug/L	97.5	90.0 - 110		0002640254
Nitrate-Nitrite Nitrogen	5270	5300	ug/L	99.4	90.0 - 110		0002640225
Nitrate-Nitrite Nitrogen	5300	5300	ug/L	100	90.0 - 110		0002640243
Nitrate-Nitrogen, Total	2190	2260	ug/L	96.9	90.0 - 110		0002640254
Nitrate-Nitrogen, Total	2220	2260	ug/L	98.2	90.0 - 110		0002640225
Nitrate-Nitrogen, Total	2220	2260	ug/L	98.2	90.0 - 110		0002640243
Nitrite-Nitrogen, Total	2980	3040	ug/L	98.0	90.0 - 110		0002640254
Nitrite-Nitrogen, Total	3050	3040	ug/L	100	90.0 - 110		0002640225
Nitrite-Nitrogen, Total	3080	3040	ug/L	101	90.0 - 110		0002640243
Ortho - Phosphate as P	3000	3260	ug/L	92.0	90.0 - 110		0002640243
Ortho - Phosphate as P	3030	3260	ug/L	92.9	90.0 - 110		0002640254
Ortho - Phosphate as P	3120	3260	ug/L	95.7	90.0 - 110		0002640225
Sulfate	10000	10000	ug/L	100	90.0 - 110		0002640225
Sulfate	10200	10000	ug/L	102	90.0 - 110		0002640254
Sulfate	9930	10000	ug/L	99.3	90.0 - 110		0002640243

LCS

Parameter	*PrepSet*	*Reading*	*Known*	*Units*	*Recover%*	*Limits*	*File*	*Out*
Bromide	179611	1020	1000	ug/L	102	90.0 - 110	0002640227	
Chloride	179611	953	1000	ug/L	95.3	90.0 - 110	0002640227	

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

179611 O Liquid Aqueous EPA Method 300.0

LCS

Parameter	PrepSet	Reading	Known	Units	Recover%	Limits	File	Out
Fluoride	179611	1040	1000	ug/L	104	90.0 - 110	0002640227	
Nitrate-Nitrite Nitrogen	179611	555	530	ug/L	105	90.0 - 110	0002640227	
Nitrate-Nitrogen, Total	179611	236	226	ug/L	104	90.0 - 110	0002640227	
Nitrite-Nitrogen, Total	179611	319	304	ug/L	105	90.0 - 110	0002640227	
Ortho - Phosphate as P	179611	330	326	ug/L	101	90.0 - 110	0002640227	
Sulfate	179611	1020	1000	ug/L	102	90.0 - 110	0002640227	

LCS Dup

Parameter	PrepSet	LCS	LCSD	Known	Limits%	LCS%	LCSD%	Units	RPD	Limit%
Bromide	179611	1020	1060	1000	90.0 - 110	102	106	ug/L	3.85	20.0
Chloride	179611	953	972	1000	90.0 - 110	95.3	97.2	ug/L	1.97	20.0
Fluoride	179611	1040	1050	1000	90.0 - 110	104	105	ug/L	0.957	20.0
Nitrate-Nitrite Nitrogen	179611	555	566	530	90.0 - 110	105	107	ug/L	1.89	20.0
Nitrate-Nitrogen, Total	179611	236	243	226	90.0 - 110	104	108	ug/L	3.77	20.0
Nitrite-Nitrogen, Total	179611	319	323	304	90.0 - 110	105	106	ug/L	0.948	20.0
Ortho - Phosphate as P	179611	330	358	326	90.0 - 110	101	110	ug/L	8.53	20.0
Sulfate	179611	1020	1090	1000	90.0 - 110	102	109	ug/L	6.64	20.0

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%
Bromide	821495	95700	101000	ND	100000	80.0 - 120	95.7	101	ug/L	5.39	30.0
Chloride	821495	205000	206000	122000	100000	80.0 - 120	83.0	84.0	ug/L	1.20	30.0
Fluoride	821495	91700	90100	ND	100000	80.0 - 120	91.7	90.1	ug/L	1.76	30.0
Nitrate-Nitrite Nitrogen	821495	49900	51900	923	53000	80.0 - 120	92.4	96.2	ug/L	4.03	30.0
Nitrate-Nitrogen, Total	821495	21200	21800	923	22600	80.0 - 120	89.7	92.4	ug/L	2.97	30.0
Nitrite-Nitrogen, Total	821495	28700	30100	ND	30400	80.0 - 120	94.4	99.0	ug/L	4.76	30.0
Ortho - Phosphate as P	821495	30000	31200	ND	32600	80.0 - 120	92.0	95.7	ug/L	3.94	30.0
Sulfate	821495	191000	195000	95000	100000	80.0 - 120	96.0	100	ug/L	4.08	30.0
Bromide	821678	483000	495000	ND	500000	80.0 - 120	96.6	99.0	ug/L	2.45	30.0
Chloride	821678	1390000	1370000	947000	500000	80.0 - 120	88.6	84.6	ug/L	4.62	30.0
Fluoride	821678	441000	433000	ND	500000	80.0 - 120	88.2	86.6	ug/L	1.83	30.0
Nitrate-Nitrite Nitrogen	821678	258000	256000	5450	265000	80.0 - 120	95.3	94.5	ug/L	0.843	30.0
Nitrate-Nitrogen, Total	821678	110000	108000	5450	113000	80.0 - 120	92.5	90.8	ug/L	1.85	30.0
Nitrite-Nitrogen, Total	821678	148000	147000	ND	152000	80.0 - 120	97.4	96.7	ug/L	0.721	30.0
Ortho - Phosphate as P	821678	144000	143000	ND	163000	80.0 - 120	88.3	87.7	ug/L	0.682	30.0
Sulfate	821678	2240000	2260000	1780000	500000	80.0 - 120	92.0	96.0	ug/L	4.26	30.0

179517 W Liquid Aqueous EPA 160.1

Blank

Parameter	Type	Result	Unit

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

179517 **W** **Liquid Aqueous** **EPA 160.1**

Blank

Parameter	*Type*	*Result*		*Unit*
Total Dissolved Solids	Blank	-0.00020	--	grams
Total Dissolved Solids	Blank	0.0000		grams

Duplicate

Parameter	*Sample*	*Type*	*Result*	*Duplicate*	*Unit*	*RPD*	*Limit%*
Total Dissolved Solids	820735	Duplicate	1240	1220	mg/L	1.63	25

LCS

Parameter		*Type*	*Result*	*Known*	*Unit*	*Recover%*	
Total Dissolved Solids	W11714	LCS	192	200	mg/L	96.0	75 - 125
Total Dissolved Solids	W11714	LCS	200	200	mg/L	100	75 - 125

Standard

Parameter	*Type*	*Result*	*Known*	*Unit*	*Recover%*	*Limits%*
Total Dissolved Solids	Standard	104	100	mg/L	104	90 - 110

RPD is Relative Percent Difference: abs(r1-r2) / mean(r1,r2) * 100%

Recover% is Recovery Percent: result / known * 100%

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Chain of Custody

04/11/2006 Page 1 of 2

Kyle Huthcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

GBMH

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EDCC 4G

Lab Number 8215Y-5X4

Phone 501/847-7077
Fax 501/847-7943

Matrix: Liquid Aqueous

Printed Name Kyle Huthcock Affiliation GBMC Signature

☐ *Plastic 1/2 gal (White)

Test	Name	Requested Test Methods
TDS	Total Dissolved Solids	EPA 160.1
1S4L	Sulfate	EPA 300.0
1CIL	Chloride	EPA Method 300.0
1N3L	Nitrate-Nitrogen, Total	EPA Method 300.0

Sample ID	Sample Description	Matrix	Date Collected	Time Collected	
82151	FC-2	L	4/19/06	1235	
82152	MW-3	L	4/19/06	1405	
82153	MW-2	L	4/18/06	0825	
82154	MW-1	L	4/18/06	0850	

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LDSClient v2.0.5 02/01/2006 www.ana-lab.com Form Created 6/22/2004 v1.1

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Chain of Custody

04/11/2006 Page 2 of 2

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

GBMH

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EDCC 4G

Lab Number

Phone 501/847-7077
Fax 501/847-7943

Ambient Conditions

Comments

4/12/06 0655	Printed Name Kyle Hathcote Affiliation GBMc	Printed Name Bill Martin Affiliation ANA-LAB	
	Signature	Signature	
4/12/06 1730	Printed Name Affiliation	Printed Name Affiliation	
	Signature	Signature	
4/13/06 0940	Printed Name Affiliation	Printed Name Affiliation	
	Signature	Signature	
	Printed Name Affiliation	Printed Name Affiliation	
	Signature	Signature	

Sample Received on Ice? [X] Yes [ ] No **Method of Shipment:** [ ] UPS [ ] Bus [ ] FedEx [ ] Lone Star [ ] Hand Delivered
Cooler/Sample Secure? [X] Yes [ ] No **Tracking/Shipping #** [ ] Other

Comments

(12)

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project 313045

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

822229 FC-1 *Received:* 04/20/2006

Liquid Aqueous *Collected by:* Kyle Hathcote *Affiliation:* GBMc & Associates 04/19/2006 0730

EPA 160.1			*Analyzed: LLW*	*04/21/2006*	*1220*	*QCgroup*	*179803*
Total Dissolved Solids	**1160**	**mg/L**	50			01	
EPA 300.0			*Analyzed: GDG*	*04/21/2006*	*005*	*QCgroup*	*179792*
Sulfate	**64.4**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*04/21/2006*	*005*	*QCgroup*	*179792*
Nitrate-Nitrogen, Total	**0.925**	**mg/L**	0.100			01	
EPA Method 300.0			*Analyzed: GDG*	*04/21/2006*	*1225*	*QCgroup*	*179792*
Chloride	**568**	**mg/L**	30.0			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822230 UTB-2 *Received:* 04/20/2006

Liquid Aqueous *Collected by:* Kyle Hathcote *Affiliation:* GBMc & Associates 04/19/2006 1150

EPA 160.1			*Analyzed: LLW*	*04/21/2006*	*1220*	*QCgroup*	*179803*
Total Dissolved Solids	**492**	**mg/L**	20			01	
EPA 300.0			*Analyzed: GDG*	*04/20/2006*	*2245*	*QCgroup*	*179792*
Sulfate	**75.4**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*04/20/2006*	*2245*	*QCgroup*	*179792*
Chloride	**39.9**	**mg/L**	3.00			01	
Nitrate-Nitrogen, Total	**42.5**	**mg/L**	0.100			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822231 UTC-1 *Received:* 04/20/2006

Liquid Aqueous *Collected by:* Kyle Hathcote *Affiliation:* GBMc & Associates 04/19/2006 1215

EPA 160.1			*Analyzed: LLW*	*04/21/2006*	*1220*	*QCgroup*	*179803*
Total Dissolved Solids	**258**	**mg/L**	10			01	
EPA 300.0			*Analyzed: GDG*	*04/20/2006*	*2305*	*QCgroup*	*179792*
Sulfate	**32.1**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*04/20/2006*	*2305*	*QCgroup*	*179792*
Chloride	**13.2**	**mg/L**	3.00			01	
Nitrate-Nitrogen, Total	**10.7**	**mg/L**	0.100			01	

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822232 **UTB-1** *Received:* 04/20/2006

Liquid Aqueous *Collected by:* Kyle Hathcote *Affiliation:* GBMc & Associates 04/19/2006 1220

EPA 160.1			*Analyzed: LLW*	*04/21/2006*	*1220*	*QCgroup*	*179803*
Total Dissolved Solids	**560**	**mg/L**	20			01	
EPA 300.0			*Analyzed: GDG*	*04/20/2006*	*2345*	*QCgroup*	*179792*
Sulfate	**73.2**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*04/20/2006*	*2345*	*QCgroup*	*179792*
Chloride	**37.9**	**mg/L**	3.00			01	
Nitrate-Nitrogen, Total	**40.9**	**mg/L**	0.100			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Qualifiers:

E - Estimated Value
B - Analyte detected in the associated method blank
! - Lab MDL > Target
J - Analyte detected below quantitation limit
S - Standard reads lower than desired
- ND in the results column is not detected above SQL

Unless otherwise noted, testing was performed at Ana-lab's corporate laboratory that holds the following Federal and State certificates: Texas Department of Health Lead Firm Certificate 2110076, EPA National Lead Laboratory Accreditation Program #637.01, Texas Department of Agriculture Soil Import Permit S-37592, Texas Department of Health Drinking Water Laboratory Certificate TX219, Oklahoma Department of Environmental Quality Drinking Water Certification Lab ID# D9913, EPA Lab Number TX00063, USEPA Approved Perchlorate Testing Lab, Oklahoma Department of Environmental Quality Laboratory Certificate 8125, Arkansas Department of Environmental Quality Certification #03-070-0, Louisiana Department of Environmental Quality Laboratory Certification (NELAP, LELAP) #02008, Louisiana Department of Health and Hospitals Drinking Water (NELAP) # LA030020, Delaware Health and Social Services (ODW) Drinking Water Approved, US Department of Energy Approved, Entidad Mexicana de Acreditacion, A.C. (EMA, in renewal as of 6/18/2004) Agua Ag-014-003/03 and Fuentes Fijas, Residuos y Ambiente Laroral FRA-013-005/03, State of Kansas Department of Health and Environment Waste Water and Solid/Hazardous Waste Cert. E-10365, Alabama Department of Environmental Management Drinking Water #41540. Ana-Lab is also accredited to the international ISO-17025 standard by the American Association for Laboratory Accreditation (A2LA Certificate # 0637-01).

These analytical results relate to the sample tested. This report may NOT be reproduced EXCEPT in FULL without written approval of Ana-Lab Corp. Unless otherwise specified, these test results meet the requirements of NELAC.
RL is the Reporting Limit (sample specific quantitation limit) and is at or above the Method Detection Limit (MDL). CAS is Chemical Abstract Service number.

Roy White

Roy White, MS, Quality Manager

Ana-Lab Corporate Laboratory P.O. Box 9000 Kilgore, TX 75663
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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

179792 O Liquid Aqueous EPA Method 300.0

Blank

Parameter	PrepSet	Reading	MDL	MQL	Units	Out	File
Chloride	179792	165	53.4	300 --	ug/L		0002642824
Fluoride	179792	ND	2.28	100	ug/L		0002642824
Nitrate-Nitrite Nitrogen	179792	ND	3.21	20.0	ug/L		0002642824
Nitrate-Nitrogen, Total	179792	ND	2.35	10.0	ug/L		0002642824
Nitrite-Nitrogen, Total	179792	ND	1.76	10.0	ug/L		0002642824
Ortho - Phosphate as P	179792	ND	6.47	10.0	ug/L		0002642824
Sulfate	179792	ND	55.3	300	ug/L		0002642824

CCV

Parameter	Reading	Known	Units	Recover%	Limits%	Out	File
Chloride	9160	10000	ug/L	91.6	90.0 - 110		0002642851
Chloride	9270	10000	ug/L	92.7	90.0 - 110		0002642821
Chloride	9310	10000	ug/L	93.1	90.0 - 110		0002642837
Fluoride	10000	10000	ug/L	100	90.0 - 110		0002642851
Fluoride	9830	10000	ug/L	98.3	90.0 - 110		0002642821
Fluoride	9840	10000	ug/L	98.4	90.0 - 110		0002642837
Nitrate-Nitrite Nitrogen	5160	5300	ug/L	97.4	90.0 - 110		0002642851
Nitrate-Nitrite Nitrogen	5320	5300	ug/L	100	90.0 - 110		0002642821
Nitrate-Nitrite Nitrogen	5360	5300	ug/L	101	90.0 - 110		0002642837
Nitrate-Nitrogen, Total	2200	2260	ug/L	97.3	90.0 - 110		0002642851
Nitrate-Nitrogen, Total	2250	2260	ug/L	99.6	90.0 - 110		0002642821
Nitrate-Nitrogen, Total	2260	2260	ug/L	100	90.0 - 110		0002642837
Nitrite-Nitrogen, Total	2960	3040	ug/L	97.4	90.0 - 110		0002642851
Nitrite-Nitrogen, Total	3070	3040	ug/L	101	90.0 - 110		0002642821
Nitrite-Nitrogen, Total	3100	3040	ug/L	102	90.0 - 110		0002642837
Ortho - Phosphate as P	3160	3260	ug/L	96.9	90.0 - 110		0002642821
Ortho - Phosphate as P	3180	3260	ug/L	97.5	90.0 - 110		0002642837
Ortho - Phosphate as P	3290	3260	ug/L	101	90.0 - 110		0002642851
Sulfate	9540	10000	ug/L	95.4	90.0 - 110		0002642851
Sulfate	9550	10000	ug/L	95.5	90.0 - 110		0002642821
Sulfate	9600	10000	ug/L	96.0	90.0 - 110		0002642837

LCS

Parameter	PrepSet	Reading	Known	Units	Recover%	Limits	File	Out
Chloride	179792	976	1000	ug/L	97.6	90.0 - 110	0002642822	
Fluoride	179792	929	1000	ug/L	92.9	90.0 - 110	0002642822	
Nitrate-Nitrite Nitrogen	179792	521	530	ug/L	98.3	90.0 - 110	0002642822	
Nitrate-Nitrogen, Total	179792	231	226	ug/L	102	90.0 - 110	0002642822	
Nitrite-Nitrogen, Total	179792	290	304	ug/L	95.4	90.0 - 110	0002642822	
Ortho - Phosphate as P	179792	316	326	ug/L	96.9	90.0 - 110	0002642822	

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

179792 O Liquid Aqueous EPA Method 300.0

LCS

Parameter	PrepSet	Reading	Known	Units	Recover%	Limits	File	Out
Sulfate	179792	1020	1000	ug/L	102	90.0 - 110	0002642822	

LCS Dup

Parameter	PrepSet	LCS	LCSD	Known	Limits%	LCS%	LCSD%	Units	RPD	Limit%
Chloride	179792	976	974	1000	90.0 - 110	97.6	97.4	ug/L	0.205	20.0
Fluoride	179792	929	931	1000	90.0 - 110	92.9	93.1	ug/L	0.215	20.0
Nitrate-Nitrite Nitrogen	179792	521	522	530	90.0 - 110	98.3	98.5	ug/L	0.203	20.0
Nitrate-Nitrogen, Total	179792	231	234	226	90.0 - 110	102	104	ug/L	1.94	20.0
Nitrite-Nitrogen, Total	179792	290	288	304	90.0 - 110	95.4	94.7	ug/L	0.736	20.0
Ortho - Phosphate as P	179792	316	330	326	90.0 - 110	96.9	101	ug/L	4.14	20.0
Sulfate	179792	1020	1030	1000	90.0 - 110	102	103	ug/L	0.976	20.0

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%
Fluoride	822076	5240	5250	586	5000	80.0 - 120	93.1	93.3	ug/L	0.215	30.0
Nitrate-Nitrite Nitrogen	822076	2780	2810	630	2650	80.0 - 120	81.1	82.3	ug/L	1.47	30.0
Nitrate-Nitrogen, Total	822076	1450	1480	415	1130	80.0 - 120	91.6	94.2	ug/L	2.80	30.0
Nitrite-Nitrogen, Total	822076	1320	1340	218	1520	80.0 - 120	72.5 *	73.8 *	ug/L	1.78	30.0
Ortho - Phosphate as P	822076	1660	1580	139	1630	80.0 - 120	93.3	88.4	ug/L	5.39	30.0
Chloride	822089	45300	45400	36400	10000	80.0 - 120	89.0	90.0	ug/L	1.12	30.0
Fluoride	822089	9200	9110	359	10000	80.0 - 120	88.4	87.5	ug/L	1.02	30.0
Nitrate-Nitrite Nitrogen	822089	4920	4960	7.45	5300	80.0 - 120	92.7	93.4	ug/L	0.752	30.0
Nitrate-Nitrogen, Total	822089	2170	2160	7.45	2260	80.0 - 120	95.7	95.2	ug/L	0.524	30.0
Nitrite-Nitrogen, Total	822089	2750	2800	ND	3040	80.0 - 120	90.5	92.1	ug/L	1.75	30.0
Ortho - Phosphate as P	822089	2450	2450	ND	3260	80.0 - 120	75.2 *	75.2 *	ug/L	0	30.0
Sulfate	822089	80300	79800	70700	10000	80.0 - 120	96.0	91.0	ug/L	5.35	30.0

179803 W Liquid Aqueous EPA 160.1

Blank

Parameter	Type	Result	Unit
Total Dissolved Solids	Blank	-0.00020	grams
Total Dissolved Solids	Blank	0.00050	grams

Duplicate

Parameter	Sample	Type	Result	Duplicate	Unit	RPD	Limit%
Total Dissolved Solids	822420	Duplicate	152	156	mg/L	2.60	25

LCS

Parameter		Type	Result	Known	Unit	Recover%	
Total Dissolved Solids	W11714	LCS	198	200	mg/L	99.0	75 - 125

Ana-Lab Corporate Laboratory P.O. Box 9000 Kilgore, TX 75663

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Report To

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GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

RPD is Relative Percent Difference: abs(r1-r2) / mean(r1,r2) * 100% Recover% is Recovery Percent: result / known * 100%

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Chain of Custody

04/13/2006 Page 1 of 2

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Bryant, AR 72022-

GBMH

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EDCC 4G

Lab Number

Phone 501/847-7077
Fax 501/847-7943

Matrix: Liquid Aqueous

Printed Name Kyle Hathcote Affiliation GBMc Signature

Plastic 1/2 gal (White)

Test	Name	Requested Test Methods
TDS	Total Dissolved Solids	EPA 160.1
IS4L	Sulfate	EPA 300.0
ICIL	Chloride	EPA Method 300.0
IN3L	Nitrate-Nitrogen, Total	EPA Method 300.0

Lab Job #	Sample ID	Bottles	Date	Time	Notes
822229	EC-1	1	4/19/06	0730	
822230	UTR-2	1	4/19/06	1150	
822231	UTC-1	1	4/19/06	1215	
822232	UTR-1	1	4/19/06	1220	

Corporate Shipping: 2600 Dudley Rd. Kilgore, TX 75662
Ark-La-Miss Region: 3100 Knight Street #2 Shreveport LA 71105
ISO-17025 # 0637-01
NELAP-accredited #02008
2004 Seal of Excellence
LDSClient v2.0.5 02/01/2006
www.ana-lab.com
Form Created 6/22/2004 v1.1

Ana-Lab Corporate Laboratory P.O. Box 9000 Kilgore, TX 75663
Phone 903/984-0551 FAX 903/984-5914 e-Mail corp@ana-lab.com NELAP-accredited #02008

Chain of Custody

04/13/2006 Page 2 of 2

Report To
Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

GBMH
111
EDCC 46

Lab Number
Phone 501/847-7077
Fax 501/847-7943

Ambient Conditions

Comments

4/19/06 1250	Printed Name Kyle Hathcote Affiliation GBMc Signature Kyle Hathcote	Printed Name Bill Martin Affiliation ANALAB Signature Bill Martin
4/20/06 1300	Printed Name Bill Martin Affiliation ANALAB Signature Bill Martin	Printed Name Affiliation Signature Accelerated
4/20/06 1648	Printed Name Affiliation Signature Accelerated	Printed Name Kathy Tarver Ana-Lab Signature
	Printed Name Affiliation Signature	Printed Name Affiliation Signature

Sample Received on Ice? [X] Yes [ ] No Method of Shipment: [ ] UPS [ ] Bus [ ] FedEx [ ] Lone Star [ ] Hand Delivered
Cooler/Sample Secure? [X] Yes [ ] No Tracking/Shipping # [ ] Other

Comments

1 °C

Corporate Shipping: 2600 Dudley Rd. Kilgore, TX 75662 Ark-La-Miss Region: 3100 Knight Street #2 Shreveport LA 71105
ISO-17025 # 0637-01 NELAP-accredited #02008 2004 Seal of Excellence
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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle
822653 UTB-2						Received: 04/21/2006
Liquid Aqueous	Collected by: Client		Affiliation: GBMc & Associates			04/20/2006 0830
EPA 160.1			Analyzed: LLW 04/24/2006 1050		QCgroup	179974
Total Dissolved Solids	512	mg/L	20		01	
EPA 300.0			Analyzed: GDG 04/22/2006 0125		QCgroup	179995
Sulfate	74.4	mg/L	3.00		01	
EPA Method 300.0			Analyzed: GDG 04/22/2006 0125		QCgroup	179995
Chloride	38.6	mg/L	3.00		01	
Nitrate-Nitrogen, Total	40.8	mg/L	0.100		01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822654 UTC-1						Received: 04/21/2006
Liquid Aqueous	Collected by: Client		Affiliation: GBMc & Associates			04/20/2006 0945
EPA 160.1			Analyzed: LLW 04/24/2006 1050		QCgroup	179974
Total Dissolved Solids	304	mg/L	10		01	
EPA 300.0			Analyzed: GDG 04/22/2006 0145		QCgroup	179995
Sulfate	34.0	mg/L	3.00		01	
EPA Method 300.0			Analyzed: GDG 04/22/2006 0145		QCgroup	179995
Chloride	13.2	mg/L	3.00		01	
Nitrate-Nitrogen, Total	11.1	mg/L	0.100		01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822655 UTB-1						Received: 04/21/2006
Liquid Aqueous	Collected by: Client		Affiliation: GBMc & Associates			04/20/2006 1015
EPA 160.1			Analyzed: LLW 04/24/2006 1050		QCgroup	179974
Total Dissolved Solids	524	mg/L	20		01	
EPA 300.0			Analyzed: GDG 04/22/2006 0205		QCgroup	179995
Sulfate	74.4	mg/L	3.00		01	
EPA Method 300.0			Analyzed: GDG 04/22/2006 0205		QCgroup	179995
Chloride	38.1	mg/L	3.00		01	
Nitrate-Nitrogen, Total	40.5	mg/L	0.100		01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle
822656 UTA-1						*Received:* 04/21/2006
Liquid Aqueous	*Collected by:* Client		*Affiliation:* GBMc & Associates			04/20/2006 1355
EPA 160.1			*Analyzed: LLW*	*04/24/2006*	*1050*	*QCgroup* *179974*
Total Dissolved Solids	**153**	**mg/L**	5			01
EPA 300.0			*Analyzed: GDG*	*04/22/2006*	*0225*	*QCgroup* *179995*
Sulfate	**3.06**	**mg/L**	3.00			01
EPA Method 300.0			*Analyzed: GDG*	*04/22/2006*	*0225*	*QCgroup* *179995*
Chloride	**35.7**	**mg/L**	3.00			01
Nitrate-Nitrogen, Total	**ND**	**mg/L**	0.100			01

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822657 UTA-2						*Received:* 04/21/2006
Liquid Aqueous	*Collected by:* Client		*Affiliation:* GBMc & Associates			04/20/2006 1415
EPA 160.1			*Analyzed: LLW*	*04/24/2006*	*1050*	*QCgroup* *179974*
Total Dissolved Solids	**406**	**mg/L**	10			01
EPA 300.0			*Analyzed: GDG*	*04/22/2006*	*0245*	*QCgroup* *179995*
Sulfate	**52.0**	**mg/L**	3.00			01
EPA Method 300.0			*Analyzed: GDG*	*04/22/2006*	*0245*	*QCgroup* *179995*
Chloride	**32.7**	**mg/L**	3.00			01
Nitrate-Nitrogen, Total	**29.2**	**mg/L**	0.100			01

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822658 UTA-3						*Received:* 04/21/2006
Liquid Aqueous	*Collected by:* Client		*Affiliation:* GBMc & Associates			04/20/2006 1430
EPA 160.1			*Analyzed: LLW*	*04/24/2006*	*1050*	*QCgroup* *179974*
Total Dissolved Solids	**372**	**mg/L**	10			01
EPA 300.0			*Analyzed: GDG*	*04/22/2006*	*0305*	*QCgroup* *179995*
Sulfate	**45.0**	**mg/L**	3.00			01
EPA Method 300.0			*Analyzed: GDG*	*04/22/2006*	*0305*	*QCgroup* *179995*
Chloride	**29.9**	**mg/L**	3.00			01
Nitrate-Nitrogen, Total	**25.3**	**mg/L**	0.100			01

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

822659 FC-2 *Received:* 04/21/2006

Liquid Aqueous *Collected by:* Client *Affiliation:* GBMc & Associates 04/20/2006 1445

EPA 160.1			*Analyzed: LLW*	*04/26/2006*	*0900*	*QCgroup*	*180231*
Total Dissolved Solids	**1100**	**mg/L**	50			01	
EPA 300.0			*Analyzed: GDG*	*04/22/2006*	*0325*	*QCgroup*	*179995*
Sulfate	**56.3**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*04/22/2006*	*0325*	*QCgroup*	*179995*
Chloride	**497**	**mg/L**	3.00			01	
Nitrate-Nitrogen, Total	**0.629**	**mg/L**	0.100			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822660 FC-1 *Received:* 04/21/2006

Liquid Aqueous *Collected by:* Client *Affiliation:* GBMc & Associates 04/20/2006 1500

EPA 160.1			*Analyzed: LLW*	*04/26/2006*	*0900*	*QCgroup*	*180231*
Total Dissolved Solids	**1410**	**mg/L**	50			01	
EPA 300.0			*Analyzed: GDG*	*04/22/2006*	*0345*	*QCgroup*	*179995*
Sulfate	**64.8**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*04/22/2006*	*0345*	*QCgroup*	*179995*
Nitrate-Nitrogen, Total	**1.11**	**mg/L**	0.100			01	
EPA Method 300.0			*Analyzed: GDG*	*04/28/2006*	*1330*	*QCgroup*	*180829*
Chloride	**629**	**mg/L**	60.0			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

822661 FC-0 *Received:* 04/21/2006

Liquid Aqueous *Collected by:* Client *Affiliation:* GBMc & Associates 04/20/2006 1515

EPA 160.1			*Analyzed: LLW*	*04/26/2006*	*0900*	*QCgroup*	*180231*
Total Dissolved Solids	**1370**	**mg/L**	50			01	
EPA 300.0			*Analyzed: GDG*	*04/22/2006*	*0405*	*QCgroup*	*179995*
Sulfate	**62.0**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*04/22/2006*	*0405*	*QCgroup*	*179995*
Nitrate-Nitrogen, Total	**1.01**	**mg/L**	0.100			01	
EPA Method 300.0			*Analyzed: GDG*	*04/28/2006*	*1748*	*QCgroup*	*180829*

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KC001.1R3

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle
822661 **FC-0**						*Received:* 04/21/2006
Liquid Aqueous	*Collected by:* Client		*Affiliation:*	GBMc & Associates		04/20/2006 1515
EPA Method 300.0			*Analyzed: GDG*	*04/28/2006*	*1748*	*QCgroup* *180829*
Chloride	**553**	**mg/L**	60.0			01

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

Qualifiers:

E - Estimated Value
B - Analyte detected in the associated method blank
! - Lab MDL > Target
J - Analyte detected below quantitation limit
S - Standard reads lower than desired
- ND in the results column is not detected above SQL

Unless otherwise noted, testing was performed at Ana-lab's corporate laboratory that holds the following Federal and State certificates: Texas Department of Health Lead Firm Certificate 2110076, EPA National Lead Laboratory Accreditation Program #637.01, Texas Department of Agriculture Soil Import Permit S-37592, Texas Department of Health Drinking Water Laboratory Certificate TX219, Oklahoma Department of Environmental Quality Drinking Water Certification Lab ID# D9913, EPA Lab Number TX00063, USEPA Approved Perchlorate Testing Lab, Oklahoma Department of Environmental Quality Laboratory Certificate 8125, Arkansas Department of Environmental Quality Certification #03-070-0, Louisiana Department of Environmental Quality Laboratory Certification (NELAP, LELAP) #02008, Louisiana Department of Health and Hospitals Drinking Water (NELAP) # LA030020, Delaware Health and Social Services (ODW) Drinking Water Approved, US Department of Energy Approved, Entidad Mexicana de Acreditacion, A.C. (EMA, in renewal as of 6/18/2004) Agua Ag-014-003/03 and Fuentes Fijas, Residuos y Ambiente Laroral FRA-013-005/03, State of Kansas Department of Health and Environment Waste Water and Solid/Hazardous Waste Cert. E-10365, Alabama Department of Environmental Management Drinking Water #41540. Ana-Lab is also accredited to the international ISO-17025 standard by the American Association for Laboratory Accreditation (A2LA Certificate # 0637-01).

RL is the Reporting Limit (sample specific quantitation limit) and is at or above the Method Detection Limit (MDL). CAS is Chemical Abstract Service number.

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

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C. H. Whiteside, Ph.D., President

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

179995 **O** **Liquid Aqueous** **EPA Method 300.0**

Blank

Parameter	*PrepSet*	*Reading*	*MDL*	*MQL*	*Units*	*Out*	*File*
Chloride	179995	178	53.4	300	ug/L		0002645822
Fluoride	179995	ND	2.28	100	ug/L		0002645822
Nitrate-Nitrite Nitrogen	179995	ND	3.21	20.0	ug/L		0002645822
Nitrate-Nitrogen, Total	179995	ND	2.35	10.0	ug/L		0002645822
Sulfate	179995	ND	55.3	300	ug/L		0002645822

CCV

Parameter	*Reading*	*Known*	*Units*	*Recover%*	*Limits%*	*Out*	*File*
Chloride	9260	10000	ug/L	92.6	90.0 - 110		0002645846
Chloride	9300	10000	ug/L	93.0	90.0 - 110		0002645819
Chloride	9320	10000	ug/L	93.2	90.0 - 110		0002645833
Fluoride	9780	10000	ug/L	97.8	90.0 - 110		0002645846
Fluoride	9800	10000	ug/L	98.0	90.0 - 110		0002645833
Fluoride	9860	10000	ug/L	98.6	90.0 - 110		0002645819
Nitrate-Nitrite Nitrogen	5270	5300	ug/L	99.4	90.0 - 110		0002645833
Nitrate-Nitrite Nitrogen	5300	5300	ug/L	100	90.0 - 110		0002645846
Nitrate-Nitrite Nitrogen	5350	5300	ug/L	101	90.0 - 110		0002645819
Nitrate-Nitrogen, Total	2220	2260	ug/L	98.2	90.0 - 110		0002645833
Nitrate-Nitrogen, Total	2240	2260	ug/L	99.1	90.0 - 110		0002645846
Nitrate-Nitrogen, Total	2250	2260	ug/L	99.6	90.0 - 110		0002645819
Sulfate	9460	10000	ug/L	94.6	90.0 - 110		0002645846
Sulfate	9490	10000	ug/L	94.9	90.0 - 110		0002645833
Sulfate	9520	10000	ug/L	95.2	90.0 - 110		0002645819

LCS

Parameter	*PrepSet*	*Reading*	*Known*	*Units*	*Recover%*	*Limits*	*File*	*Out*
Chloride	179995	976	1000	ug/L	97.6	90.0 - 110	0002645820	
Fluoride	179995	922	1000	ug/L	92.2	90.0 - 110	0002645820	
Nitrate-Nitrite Nitrogen	179995	507	530	ug/L	95.7	90.0 - 110	0002645820	
Nitrate-Nitrogen, Total	179995	225	226	ug/L	99.6	90.0 - 110	0002645820	
Sulfate	179995	997	1000	ug/L	99.7	90.0 - 110	0002645820	

LCS Dup

Parameter	*PrepSet*	*LCS*	*LCSD*	*Known*	*Limits%*	*LCS%*	*LCSD%*	*Units*	*RPD*	*Limit%*
Chloride	179995	976	978	1000	90.0 - 110	97.6	97.8	ug/L	0.205	20.0
Fluoride	179995	922	922	1000	90.0 - 110	92.2	92.2	ug/L	0	20.0
Nitrate-Nitrite Nitrogen	179995	507	509	530	90.0 - 110	95.7	96.0	ug/L	0.313	20.0
Nitrate-Nitrogen, Total	179995	225	227	226	90.0 - 110	99.6	100	ug/L	0.401	20.0
Sulfate	179995	997	998	1000	90.0 - 110	99.7	99.8	ug/L	0.100	20.0

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Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

J 79995 **O Liquid Aqueous** **EPA Method 300.0**

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%
Chloride	822076 ---	648000	653000	533000	100000	80.0 - 120	115	120	ug/L	4.26	30.0
Fluoride	822076	87800	88600	ND	100000	80.0 - 120	87.8	88.6	ug/L	0.907	30.0
Nitrate-Nitrite Nitrogen	822076	50100	53100	826	53000	80.0 - 120	93.0	98.6	ug/L	5.85	30.0
Nitrate-Nitrogen, Total	822076	21700	22000	ND	22600	80.0 - 120	96.0	97.3	ug/L	1.35	30.0
Sulfate	822076	206000	210000	117000	100000	80.0 - 120	89.0	93.0	ug/L	4.40	30.0
Chloride	822593	280000	280000	202000	100000	80.0 - 120	78.0 *	78.0 *	ug/L	0	30.0
Fluoride	822593	115000	114000	21600	100000	80.0 - 120	93.4	92.4	ug/L	1.08	30.0
Nitrate-Nitrite Nitrogen	822593	51800	51200	ND	53000	80.0 - 120	97.7	96.6	ug/L	1.13	30.0
Nitrate-Nitrogen, Total	822593	22300	21800	ND	22600	80.0 - 120	98.7	96.5	ug/L	2.25	30.0
Sulfate	822593	106000	102000	13400	100000	80.0 - 120	92.6	88.6	ug/L	4.42	30.0

180829 **O Liquid Aqueous** **EPA Method 300.0**

Blank

Parameter	PrepSet	Reading	MDL	MQL	Units	Out	File
Chloride	180829	204	53.4	300	ug/L		0002657498
Fluoride	180829	ND	2.28	100	ug/L		0002657498
Nitrate	180829	ND	10.3	50.0	ug/L		0002657498
Nitrate-Nitrite Nitrogen	180829	ND	3.21	20.0	ug/L		0002657498
Nitrate-Nitrogen, Total	180829	ND	2.35	10.0	ug/L		0002657498
Nitrite	180829	ND	5.49	50.0	ug/L		0002657498
Nitrite-Nitrogen, Total	180829	ND	1.76	10.0	ug/L		0002657498
Ortho - Phosphate as P	180829	ND	6.47	10.0	ug/L		0002657498
Sulfate	180829	ND	55.3	300	ug/L		0002657498

CCV

Parameter	Reading	Known	Units	Recover%	Limits%	Out	File
Chloride	9260	10000	ug/L	92.6	90.0 - 110		0002657510
Chloride	9310	10000	ug/L	93.1	90.0 - 110		0002657497
Chloride	9310	10000	ug/L	93.1	90.0 - 110		0002657523
Fluoride	10100	10000	ug/L	101	90.0 - 110		0002657497
Fluoride	10100	10000	ug/L	101	90.0 - 110		0002657510
Fluoride	10100	10000	ug/L	101	90.0 - 110		0002657523
Nitrate	9870	10000	ug/L	98.7	90.0 - 110		0002657497
Nitrate	9900	10000	ug/L	99.0	90.0 - 110		0002657510
Nitrate	9940	10000	ug/L	99.4	90.0 - 110		0002657523
Nitrate-Nitrite Nitrogen	5290	5300	ug/L	99.8	90.0 - 110		0002657510
Nitrate-Nitrite Nitrogen	5300	5300	ug/L	100	90.0 - 110		0002657497
Nitrate-Nitrite Nitrogen	5350	5300	ug/L	101	90.0 - 110		0002657523
Nitrate-Nitrogen, Total	2230	2260	ug/L	98.7	90.0 - 110		0002657497

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

180829 **O** **Liquid Aqueous** **EPA Method 300.0**

CCV

Parameter	Reading	Known	Units	Recover%	Limits%	Out	File
Nitrate-Nitrogen, Total	2230	2260	ug/L	98.7	90.0 - 110		0002657510
Nitrate-Nitrogen, Total	2240	2260	ug/L	99.1	90.0 - 110		0002657523
Nitrite	10000	10000	ug/L	100	90.0 - 110		0002657510
Nitrite	10100	10000	ug/L	101	90.0 - 110		0002657497
Nitrite	10200	10000	ug/L	102	90.0 - 110		0002657523
Nitrite-Nitrogen, Total	3060	3040	ug/L	101	90.0 - 110		0002657510
Nitrite-Nitrogen, Total	3070	3040	ug/L	101	90.0 - 110		0002657497
Nitrite-Nitrogen, Total	3110	3040	ug/L	102	90.0 - 110		0002657523
Ortho - Phosphate as P	3150	3260	ug/L	96.6	90.0 - 110		0002657497
Ortho - Phosphate as P	3180	3260	ug/L	97.5	90.0 - 110		0002657510
Ortho - Phosphate as P	3180	3260	ug/L	97.5	90.0 - 110		0002657523
Sulfate	9550	10000	ug/L	95.5	90.0 - 110		0002657510
Sulfate	9570	10000	ug/L	95.7	90.0 - 110		0002657497
Sulfate	9580	10000	ug/L	95.8	90.0 - 110		0002657523

LCS

Parameter	PrepSet	Reading	Known	Units	Recover%	Limits	File	Out
Chloride	180829	992	1000	ug/L	99.2	90.0 - 110	0002657499	
Fluoride	180829	1090	1000	ug/L	109	90.0 - 110	0002657499	
Nitrate	180829	1050	1000	ug/L	105	90.0 - 110	0002657499	
Nitrate-Nitrite Nitrogen	180829	534	530	ug/L	101	90.0 - 110	0002657499	
Nitrate-Nitrogen, Total	180829	237	226	ug/L	105	90.0 - 110	0002657499	
Nitrite	180829	974	1000	ug/L	97.4	90.0 - 110	0002657499	
Nitrite-Nitrogen, Total	180829	297	304	ug/L	97.7	90.0 - 110	0002657499	
Ortho - Phosphate as P	180829	336	326	ug/L	103	90.0 - 110	0002657499	
Sulfate	180829	1070	1000	ug/L	107	90.0 - 110	0002657499	

LCS Dup

Parameter	PrepSet	LCS	LCSD	Known	Limits%	LCS%	LCSD%	Units	RPD	Limit%
Chloride	180829	992	1000	1000	90.0 - 110	99.2	100	ug/L	0.803	20.0
Nitrate	180829	1050	1050	1000	90.0 - 110	105	105	ug/L	0	20.0
Nitrate-Nitrite Nitrogen	180829	534	536	530	90.0 - 110	101	101	ug/L	0	20.0
Nitrate-Nitrogen, Total	180829	237	236	226	90.0 - 110	105	104	ug/L	0.957	20.0
Nitrite	180829	974	984	1000	90.0 - 110	97.4	98.4	ug/L	1.02	20.0
Nitrite-Nitrogen, Total	180829	297	300	304	90.0 - 110	97.7	98.7	ug/L	1.02	20.0
Ortho - Phosphate as P	180829	336	310	326	90.0 - 110	103	95.1	ug/L	7.98	20.0
Sulfate	180829	1070	1060	1000	90.0 - 110	107	106	ug/L	0.939	20.0

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%

Ana-Lab Corporate Laboratory P.O. Box 9000 Kilgore, TX 75663
Phone 903/984-0551 FAX 903/984-5914 e-Mail corp@ana-lab.com NELAP-accredited #02008

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

130829 **O** **Liquid Aqueous** **EPA Method 300.0**

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%
Chloride	822660	781000	783000	629000	200000	80.0 - 120	76.0 *	77.0 *	ug/L	1.31	30.0
Fluoride	822660	209000	210000	ND	200000	80.0 - 120	104	105	ug/L	0.957	30.0
Nitrate	822660	199000	191000	ND	200000	80.0 - 120	99.5	95.5	ug/L	4.10	30.0
Nitrate-Nitrite Nitrogen	822660	101000	98200	ND	106000	80.0 - 120	95.3	92.6	ug/L	2.87	30.0
Nitrate-Nitrogen, Total	822660	44800	43000	ND	45200	80.0 - 120	99.1	95.1	ug/L	4.12	30.0
Nitrite	822660	184000	181000	ND	200000	80.0 - 120	92.0	90.5	ug/L	1.64	30.0
Nitrite-Nitrogen, Total	822660	56200	55200	ND	60800	80.0 - 120	92.4	90.8	ug/L	1.75	30.0
Ortho - Phosphate as P	822660	63400	61600	ND	65200	80.0 - 120	97.2	94.5	ug/L	2.82	30.0
Sulfate	822660	277000	277000	85700	200000	80.0 - 120	95.6	95.6	ug/L	0	30.0
Chloride	822661	714000	708000	553000	200000	80.0 - 120	80.5	77.5 *	ug/L	3.80	30.0
Fluoride	822661	201000	205000	ND	200000	80.0 - 120	100	102	ug/L	1.98	30.0
Nitrate	822661	201000	195000	ND	200000	80.0 - 120	100	97.5	ug/L	2.53	30.0
Nitrate-Nitrite Nitrogen	822661	101000	101000	ND	106000	80.0 - 120	95.3	95.3	ug/L	0	30.0
Nitrate-Nitrogen, Total	822661	45400	44200	ND	45200	80.0 - 120	100	97.8	ug/L	2.22	30.0
Nitrite	822661	184000	186000	ND	200000	80.0 - 120	92.0	93.0	ug/L	1.08	30.0
Nitrite-Nitrogen, Total	822661	56000	56600	ND	60800	80.0 - 120	92.1	93.1	ug/L	1.08	30.0
Ortho - Phosphate as P	822661	59400	58000	ND	65200	80.0 - 120	91.1	89.0	ug/L	2.33	30.0
Sulfate	822661	275000	265000	82600	200000	80.0 - 120	96.2	91.2	ug/L	5.34	30.0

130974 **W** **Liquid Aqueous** **EPA 160.1**

Blank

Parameter	Type	Result	Unit
Total Dissolved Solids	Blank	0.00040	grams
Total Dissolved Solids	Blank	0.00050	grams

Duplicate

Parameter	Sample	Type	Result	Duplicate	Unit	RPD	Limit%
Total Dissolved Solids	822468	Duplicate	4220	4300	mg/L	1.88	25

LCS

Parameter		Type	Result	Known	Unit	Recover%	
Total Dissolved Solids	W11714	LCS	208	200	mg/L	104	75 - 125

Standard

Parameter	Type	Result	Known	Unit	Recover%	Limits%
Total Dissolved Solids	Standard	96.0	100	mg/L	96.0	90 - 110

130231 **W** **Liquid Aqueous** **EPA 160.1**

Blank

Parameter	Type	Result	Unit

Ana-Lab Corporate Laboratory P.O. Box 9000 Kilgore, TX 75663

Phone 903/984-0551 FAX 903/984-5914 e-Mail corp@ana-lab.com NELAP-accredited #02008

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

180231 **W** **Liquid Aqueous** **EPA 160.1**

Blank

Parameter	*Type*	*Result*	*Unit*
Total Dissolved Solids	Blank	-0.00020	grams
Total Dissolved Solids	Blank	0.00030	grams

Duplicate

Parameter	*Sample*	*Type*	*Result*	*Duplicate*	*Unit*	*RPD*	*Limit%*
Total Dissolved Solids	822659	Duplicate	1060	1150	mg/L	8.14	25

LCS

Parameter	*Type*	*Result*	*Known*	*Unit*	*Recover%*	
Total Dissolved Solids	W11714 LCS	202	200	mg/L	101	75 - 125

Standard

Parameter	*Type*	*Result*	*Known*	*Unit*	*Recover%*	*Limits%*
Total Dissolved Solids	Standard	90.0	100	mg/L	90.0	90 - 110

RPD is Relative Percent Difference: abs(r1-r2) / mean(r1,r2) * 100%

Recover% is Recovery Percent: result / known * 100%

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Chain of Custody

04/11/2006 Page 1 of 2

Kyle Hatheote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

GBMH
111
EDCC 46

Lab Number

Phone 501/847-7077
Fax 501/847-7943

Matrix: Liquid Aqueous

Printed Name Jan-Ann Brown Affiliation GBMC Signature

☐ *Plastic 1/2 gal (White)

Test	Name	Requested Test Methods
TDS	Total Dissolved Solids	EPA 160.1
1S4L	Sulfate	EPA 300.0
1CIL	Chloride	EPA Method 300.0
1N3L	Nitrate-Nitrogen, Total	EPA Method 300.0

[illegible]	UTB-2	1	4/20/06	0830	
[illegible]	UTC-1	1	4/20/06	0945	
[illegible]	UTB-1	1	4/20/06	1015	
[illegible]	UTA-1	1	4/20/06	1355	
[illegible]	UTA-2	1	4/20/06	1415	
[illegible]	UTA-3	1	4/20/06	1430	
[illegible]	FC-2	1	4/20/06	1445	
[illegible]	FC-1	1	4/20/06	1500	
[illegible]	FC-0	1	4/20/06	1515	

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Ark-La-Miss Region: 3100 Knight Street #2 Shreveport LA 71105

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Chain of Custody

04/11/2006 Page 2 of 2

Report To
Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

GBMH
111
EDCC 4G

Lab Number
Phone 501/847-7077
Fax 501/847-7943

Ambient Conditions

Comments

4/20/06 1535	Printed Name Jonathan Brown Affiliation Calmo Signature	Printed Name Bill MARTIN Affiliation AWALAB Signature	
4/21/06 1530	Printed Name Bill Martin Affiliation AWALAB Signature	Printed Name Affiliation Signature Accelerated	
4/21/06 1645	Printed Name Affiliation Accelerated Signature	Printed Name Affiliation Signature	
	Printed Name Affiliation Signature	Printed Name Affiliation Signature	

Sample Recieved on Ice? [X] Yes [ ] No
Cooler/Sample Secure? [X] Yes [ ] No
Method of Shipment: [ ] UPS [ ] Bus [ ] FedEx [ ] Lone Star [ ] Hand Delivered [X] Other
Tracking/Shipping #

Comments

(1)

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ANA-LAB CORP.® COMPLETE SERVICE LAB

Report To:

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

[redacted] FC-2

Received: 06/01/2006

Liquid Aqueous — *Collected by:* J Brown — *Affiliation:* GBMc & Associates — 05/31/2006 0915

EPA 160.1			*Analyzed:* LLW	06/02/2006	0940	*QCgroup*	184659	
Total Dissolved Solids	710	mg/L	50			01		
EPA 300.0			*Analyzed:* GDG	06/02/2006	0324	*QCgroup*	184848	
Sulfate	15.8	mg/L	3.00			01		
EPA Method 300.0			*Analyzed:* GDG	06/02/2006	0324	*QCgroup*	184848	
Chloride	375	mg/L	3.00			01		
Nitrate-Nitrogen, Total	0.433	mg/L	0.100			01		

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

[redacted] UTA-3

Received: 06/01/2006

Liquid Aqueous — *Collected by:* J Brown — *Affiliation:* GBMc & Associates — 05/31/2006 0955

EPA 160.1			*Analyzed:* LLW	06/02/2006	0940	*QCgroup*	184659	
Total Dissolved Solids	130	mg/L	5			01		
EPA 300.0			*Analyzed:* GDG	06/02/2006	0346	*QCgroup*	184848	
Sulfate	11.7	mg/L	3.00			01		
EPA Method 300.0			*Analyzed:* GDG	06/02/2006	0346	*QCgroup*	184848	
Chloride	19.8	mg/L	3.00			01		
Nitrate-Nitrogen, Total	1.13	mg/L	0.100			01		

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

[redacted] UTA-2

Received: 06/01/2006

Liquid Aqueous — *Collected by:* J Brown — *Affiliation:* GBMc & Associates — 05/31/2006 1030

EPA 160.1			*Analyzed:* LLW	06/02/2006	0940	*QCgroup*	184659	
Total Dissolved Solids	142	mg/L	10			01		
EPA 300.0			*Analyzed:* GDG	06/02/2006	0407	*QCgroup*	184848	
Sulfate	11.1	mg/L	3.00			01		
EPA Method 300.0			*Analyzed:* GDG	06/02/2006	0407	*QCgroup*	184848	
Chloride	26.9	mg/L	3.00			01		
Nitrate-Nitrogen, Total	1.98	mg/L	0.100			01		

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

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ANA-LAB CORP. COMPLETE SERVICE LAB

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

831754 **UTB-2** *Received:* 06/01/2006

Liquid Aqueous *Collected by:* J Brown *Affiliation:* GBMc & Associates 05/31/2006 1105

EPA 160.1			*Analyzed: LLW*	*06/02/2006*	*0940*	*QCgroup*	*184659*
Total Dissolved Solids	**206**	**mg/L**	10			01	
EPA 300.0			*Analyzed: GDG*	*06/02/2006*	*0428*	*QCgroup*	*184848*
Sulfate	**51.8**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*06/02/2006*	*0428*	*QCgroup*	*184848*
Chloride	**19.6**	**mg/L**	3.00			01	
Nitrate-Nitrogen, Total	**16.9**	**mg/L**	0.100			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

831755 **UTB-1** *Received:* 06/01/2006

Liquid Aqueous *Collected by:* J Brown *Affiliation:* GBMc & Associates 05/31/2006 1110

EPA 160.1			*Analyzed: LLW*	*06/02/2006*	*0940*	*QCgroup*	*184659*
Total Dissolved Solids	**178**	**mg/L**	10			01	
EPA 300.0			*Analyzed: GDG*	*06/02/2006*	*0450*	*QCgroup*	*184848*
Sulfate	**49.5**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*06/02/2006*	*0450*	*QCgroup*	*184848*
Chloride	**18.7**	**mg/L**	3.00			01	
Nitrate-Nitrogen, Total	**15.1**	**mg/L**	0.100			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

831756 **UTC-1** *Received:* 06/01/2006

Liquid Aqueous *Collected by:* J Brown *Affiliation:* GBMc & Associates 05/31/2006 1115

EPA 160.1			*Analyzed: LLW*	*06/02/2006*	*0940*	*QCgroup*	*184659*
Total Dissolved Solids	**206**	**mg/L**	10			01	
EPA 300.0			*Analyzed: GDG*	*06/02/2006*	*0511*	*QCgroup*	*184848*
Sulfate	**29.2**	**mg/L**	3.00			01	
EPA Method 300.0			*Analyzed: GDG*	*06/02/2006*	*0511*	*QCgroup*	*184848*
Chloride	**13.0**	**mg/L**	3.00			01	
Nitrate-Nitrogen, Total	**1.57**	**mg/L**	0.100			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

Ana-Lab Corp. P.O. Box 9000 Kilgore, TX 75663

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ANA-LAB CORP. THE COMPLETE SERVICE LAB

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Results for Client GBMH

Parameter	Results	Units	RL	Flags	CAS	Bottle

881757 FC-1

Received: 06/01/2006

Liquid Aqueous — *Collected by:* J Brown — *Affiliation:* GBMc & Associates — 05/31/2006 1210

EPA 160.1							
Total Dissolved Solids	**1200**	**mg/L**	*Analyzed:* LLW 50	*06/02/2006*	*0940*	*QCgroup* 01	*184659*
EPA 300.0							
Sulfate	**5.90**	**mg/L**	*Analyzed:* GDG 3.00	*06/02/2006*	*0532*	*QCgroup* 01	*184848*
EPA Method 300.0							
Nitrate-Nitrogen, Total	**0.217**	**mg/L**	*Analyzed:* GDG 0.100	*06/02/2006*	*0532*	*QCgroup* 01	*184848*
EPA Method 300.0							
Chloride	**689**	**mg/L**	*Analyzed:* KLB 150	*06/02/2006*	*1546*	*QCgroup* 01	*184878*

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

881758 UTA-1

Received: 06/01/2006

Liquid Aqueous — *Collected by:* J Brown — *Affiliation:* GBMc & Associates — 05/31/2006 1240

EPA 160.1							
Total Dissolved Solids	**300**	**mg/L**	*Analyzed:* LLW 10	*06/05/2006*	*0945*	*QCgroup* 01	*184831*
EPA 300.0							
Sulfate	**5.54**	**mg/L**	*Analyzed:* GDG 3.00	*06/02/2006*	*0719*	*QCgroup* 01	*184848*
EPA Method 300.0							
Chloride	**115**	**mg/L**	*Analyzed:* GDG 3.00	*06/02/2006*	*0719*	*QCgroup* 01	*184848*
Nitrate-Nitrogen, Total	**ND**	**mg/L**	0.100			01	

The above methods that we used are approved for NPDES reporting as listed in 40 CFR 136 Table 1B or Ana-Lab has specific approval from EPA to use this method under 40 CFR 136.

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ANA-LAB CORP. COMPLETE SERVICE LAB

Project [redacted]

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Qualifiers:

E - Estimated Value
B - Analyte detected in the associated method blank
! - Lab MDL > Target
J - Analyte detected below quantitation limit
S - Standard reads lower than desired
- ND in the results column is not detected above SQL

Unless otherwise noted, testing was performed at Ana-lab's corporate laboratory that holds the following Federal and State certificates: Texas Department of Health Lead Firm Certificate 2110076, EPA National Lead Laboratory Accreditation Program #637.01, Texas Department of Agriculture Soil Import Permit S-37592, Texas Department of Health Drinking Water Laboratory Certificate TX219, Oklahoma Department of Environmental Quality Drinking Water Certification Lab ID# D9913, EPA Lab Number TX00063, USEPA Approved Perchlorate Testing Lab, Oklahoma Department of Environmental Quality Laboratory Certificate8125, Arkansas Department of Environmental Quality Certification #03-070-0, Louisiana Department of Environmental Quality Laboratory Certification(NELAP, LELAP) #02008, Louisiana Department of Health and Hospitals Drinking Water(NELAP) # LA030020, Delaware Health and Social Services (ODW) Drinking Water Approved, US Department of Energy Approved, Entidad Mexicana de Acreditacion, A.C. (EMA, in renewal as of 6/18/2004) Agua Ag-014-003/03 and Fuentes Fijas, Residuos y Ambiente Laroral FRA-013-005/03, State of Kansas Department of Health Environment Waste Water and Solid/Hazardous Waste Cert. E-10365, Alabama Department of Environmental Management Drinking Water #41540. Ana-Lab is also accredited to the international ISO-17025 standard by the American Association for Laboratory Accreditation (A2LA Certificate # 0637-01).

These analytical results relate to the sample tested. This report may NOT be reproduced EXCEPT in FULL without written approval of Ana-Lab Corp. Unless otherwise specified, these test results meet the requirements of NELAC.
RL is the Reporting Limit (sample specific quantitation limit) and is at or above the Method Detection Limit (MDL). CAS is Chemical Abstract Service number.

C. H. Whiteside

C. H. Whiteside, Ph.D., President

2005 SEAL OF EXCELLENCE PROGRAM

Ana-Lab Corporate Laboratory P.O. Box 9000 Kilgore, TX 75663

Phone 903/984-0551 FAX 903/984-5914 e-Mail corp@ana-lab.com NELAP-accredited #02008

Chain of Custody

05/25/2006 Page 1 of 2

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

GBMH

111

EDCC4G

Lab Number

Phone 501/847-7077
Fax 501/847-7943

Matrix: Liquid Aqueous

Printed Name Jonathan Brown *Affiliation* GBMc *Signature* Jonathan Brown

☑ ***Plastic 1/2 gal (White)**

Test	*Name*	*Requested Test Methods*
TDS	Total Dissolved Solids	EPA 160.1
!S4L	Sulfate	EPA 300.0
!ClL	Chloride	EPA Method 300.0
!N3L	Nitrate-Nitrogen, Total	EPA Method 300.0

	FC-2	1	5/31/06	0915	
	UTA-3	1	5/31/06	0955	
	UTA-2	1	5/31/06	1030	
	UTB-2	1	5/31/06	1105	
	UTB-1	1	5/31/06	1110	
	UTC-1	1	5/31/06	1115	
	FC-1	1	5/31/06	1210	
	UTA-1	1	5/31/06	1240	

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Chain of Custody

05/25/2006 Page 2 of 2

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

GBMH
111
EDCC 4G

Lab Number

Phone 501/847-7077
Fax 501/847-7943

Ambient Conditions Overcast, humid

Comments

5/31/06 1310	Printed Name Jonathan Brown Affiliation GBMC Signature	Printed Name BILL MARTIN Affiliation ANA-LAB Signature
6/1/06 1130	Printed Name Bill Martin Affiliation ANALAB Signature	Printed Name Velocity Affiliation Signature
6-1-06 1945	Printed Name Velocity Affiliation Signature	Printed Name Affiliation Signature
	Printed Name Affiliation Signature	Printed Name Affiliation Signature

Sample Recieved on Ice? [x] Yes [ ] No Method of Shipment: [ ] UPS [ ] Bus [ ] FedEx [ ] Lone Star [ ] Hand Delivered
Cooler/Sample Secure? [x] Yes [ ] No Tracking/Shipping # [x] Other

Comments

(12)

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ANA-LAB CORP. COMPLETE SERVICE LAB

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

[redacted] O Liquid Aqueous EPA Method 300.0

Blank

Parameter	PrepSet	Reading	MDL	MQL	Units	Out	File
Chloride	184848	118	53.4	300	ug/L		0002717929
Fluoride	184848	ND	2.28	100	ug/L		0002717929
Nitrate	184848	ND	10.3	50.0	ug/L		0002717929
Nitrate-Nitrite Nitrogen	184848	ND	3.21	20.0	ug/L		0002717929
Nitrate-Nitrogen, Total	184848	ND	2.35	10.0	ug/L		0002717929
Nitrite	184848	ND	5.49	50.0	ug/L		0002717929
Nitrite-Nitrogen, Total	184848	ND	1.76	10.0	ug/L		0002717929
Ortho - Phosphate as P	184848	ND	6.47	10.0	ug/L		0002717929
Sulfate	184848	ND	55.3	300	ug/L		0002717929

CCV

Parameter	Reading	Known	Units	Recover%	Limits%	Out	File
Chloride	10100	10000	ug/L	101	90.0 - 110		0002717926
Chloride	10100	10000	ug/L	101	90.0 - 110		0002717942
[illegible]ide	10200	10000	ug/L	102	90.0 - 110		0002717954
Fluoride	10100	10000	ug/L	101	90.0 - 110		0002717926
Fluoride	10200	10000	ug/L	102	90.0 - 110		0002717942
Fluoride	10200	10000	ug/L	102	90.0 - 110		0002717954
Nitrate	10300	10000	ug/L	103	90.0 - 110		0002717926
Nitrate	10300	10000	ug/L	103	90.0 - 110		0002717942
Nitrate	10400	10000	ug/L	104	90.0 - 110		0002717954
Nitrate-Nitrite Nitrogen	5440	5300	ug/L	103	90.0 - 110		0002717926
Nitrate-Nitrite Nitrogen	5500	5300	ug/L	104	90.0 - 110		0002717942
Nitrate-Nitrite Nitrogen	5510	5300	ug/L	104	90.0 - 110		0002717954
Nitrate-Nitrogen, Total	2320	2260	ug/L	103	90.0 - 110		0002717926
Nitrate-Nitrogen, Total	2340	2260	ug/L	104	90.0 - 110		0002717942
Nitrate-Nitrogen, Total	2360	2260	ug/L	104	90.0 - 110		0002717954
Nitrite	10200	10000	ug/L	102	90.0 - 110		0002717926
Nitrite	10300	10000	ug/L	103	90.0 - 110		0002717954
Nitrite	10400	10000	ug/L	104	90.0 - 110		0002717942
Nitrite-Nitrogen, Total	3120	3040	ug/L	103	90.0 - 110		0002717926
Nitrite-Nitrogen, Total	3150	3040	ug/L	104	90.0 - 110		0002717954
Nitrite-Nitrogen, Total	3160	3040	ug/L	104	90.0 - 110		0002717942
Ortho - Phosphate as P	3340	3260	ug/L	102	90.0 - 110		0002717926
Ortho - Phosphate as P	3380	3260	ug/L	104	90.0 - 110		0002717942
Ortho - Phosphate as P	3390	3260	ug/L	104	90.0 - 110		0002717954
Sulfate	10400	10000	ug/L	104	90.0 - 110		0002717926
Sulfate	10400	10000	ug/L	104	90.0 - 110		0002717942
Sulfate	10400	10000	ug/L	104	90.0 - 110		0002717954

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ANA-LAB CORP. COMPLETE SERVICE LAB

Report To

Kyle Hathcote
GBMc & Associates
219 Brown Lane
Bryant, AR 72022-

Project [redacted]

Quality Control

[redacted] O Liquid Aqueous EPA Method 300.0

LCS

Parameter	PrepSet	Reading	Known	Units	Recover%	Limits	File	Out
Chloride	184848	996	1000	ug/L	99.6	90.0 - 110	0002717927	
Fluoride	184848	1010	1000	ug/L	101	90.0 - 110	0002717927	
Nitrate	184848	981	1000	ug/L	98.1	90.0 - 110	0002717927	
Nitrate-Nitrite Nitrogen	184848	509	530	ug/L	96.0	90.0 - 110	0002717927	
Nitrate-Nitrogen, Total	184848	221	226	ug/L	97.8	90.0 - 110	0002717927	
Nitrite	184848	945	1000	ug/L	94.5	90.0 - 110	0002717927	
Nitrite-Nitrogen, Total	184848	288	304	ug/L	94.7	90.0 - 110	0002717927	
Ortho - Phosphate as P	184848	341	326	ug/L	105	90.0 - 110	0002717927	
Sulfate	184848	931	1000	ug/L	93.1	90.0 - 110	0002717927	

LCS Dup

Parameter	PrepSet	LCS	LCSD	Known	Limits%	LCS%	LCSD%	Units	RPD	Limit%
Chloride	184848	996	1030	1000	90.0 - 110	99.6	103	ug/L	3.36	20.0
F[illegible]ide	184848	1010	1010	1000	90.0 - 110	101	101	ug/L	0	20.0
[illegible]	184848	981	990	1000	90.0 - 110	98.1	99.0	ug/L	0.913	20.0
Nitrate-Nitrite Nitrogen	184848	509	532	530	90.0 - 110	96.0	100	ug/L	4.08	20.0
Nitrate-Nitrogen, Total	184848	221	224	226	90.0 - 110	97.8	99.1	ug/L	1.32	20.0
Nitrite	184848	945	1010	1000	90.0 - 110	94.5	101	ug/L	6.65	20.0
Nitrite-Nitrogen, Total	184848	288	308	304	90.0 - 110	94.7	101	ug/L	6.44	20.0
Ortho - Phosphate as P	184848	341	321	326	90.0 - 110	105	98.5	ug/L	6.39	20.0
Sulfate	184848	931	922	1000	90.0 - 110	93.1	92.2	ug/L	0.971	20.0

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%
Chloride	831513	171000	171000	126000	50000	80.0 - 120	90.0	90.0	ug/L	0	30.0
Fluoride	831513	47900	48700	ND	50000	80.0 - 120	95.8	97.4	ug/L	1.66	30.0
Nitrate	831513	50100	48300	ND	50000	80.0 - 120	100	96.6	ug/L	3.46	30.0
Nitrate-Nitrite Nitrogen	831513	26400	25800	ND	26500	80.0 - 120	99.6	97.4	ug/L	2.23	30.0
Nitrate-Nitrogen, Total	831513	11300	10900	ND	11300	80.0 - 120	100	96.5	ug/L	3.56	30.0
Nitrite	831513	49600	48600	ND	50000	80.0 - 120	99.2	97.2	ug/L	2.04	30.0
Nitrite-Nitrogen, Total	831513	15100	14800	ND	15200	80.0 - 120	99.3	97.4	ug/L	1.93	30.0
Ortho - Phosphate as P	831513	15900	15200	ND	16300	80.0 - 120	97.5	93.3	ug/L	4.40	30.0
Sulfate	831513	57100	54900	4970	50000	80.0 - 120	104	99.9	ug/L	4.02	30.0
Chloride	831756	21800	21900	13000	10000	80.0 - 120	88.0	89.0	ug/L	1.13	30.0
Fluoride	831756	9930	9910	ND	10000	80.0 - 120	99.3	99.1	ug/L	0.202	30.0
Nitrate	831756	17000	16900	6980	10000	80.0 - 120	100	99.2	ug/L	0.803	30.0
Nitrate-Nitrite Nitrogen	831756	7100	6900	1570	5300	80.0 - 120	104	101	ug/L	2.93	30.0
Nitrate-Nitrogen, Total	831756	3840	3810	1570	2260	80.0 - 120	100	99.1	ug/L	0.904	30.0
Nitrite	831756	10700	10100	ND	10000	80.0 - 120	107	101	ug/L	5.77	30.0
Nitrite-Nitrogen, Total	831756	3260	3090	ND	3040	80.0 - 120	107	102	ug/L	4.78	30.0

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Quality Control

[redacted] O Liquid Aqueous **EPA Method 300.0**

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%
Ortho - Phosphate as P	831756	3040	3220	ND	3260	80.0 - 120	93.3	98.8	ug/L	5.73	30.0
Sulfate	831756	38300	38700	29200	10000	80.0 - 120	91.0	95.0	ug/L	4.30	30.0

[redacted] O Liquid Aqueous **EPA Method 300.0**

Blank

Parameter	PrepSet	Reading	MDL	MQL	Units	Out	File
Chloride	184878	18.1	16.3	100	ug/L		0002718370

CCV

Parameter	Reading	Known	Units	Recover%	Limits%	Out	File
Chloride	10400	10000	ug/L	104	90.0 - 110		0002718379
Chloride	10500	10000	ug/L	105	90.0 - 110		0002718368

LCS

Parameter	PrepSet	Reading	Known	Units	Recover%	Limits	File	Out
Chloride	184878	1080	1000	ug/L	108	90.0 - 110	0002718369	

LCS Dup

Parameter	PrepSet	LCS	LCSD	Known	Limits%	LCS%	LCSD%	Units	RPD	Limit%
Chloride	184878	1080	1080	1000	90.0 - 110	108	108	ug/L	0	20.0

MS

Parameter	Sample	MS	MSD	UNK	Known	Limits	MS%	MSD%	Units	RPD	Limit%
Chloride	831757	1210000	1240000	689000	500000	80.0 - 120	104	110	ug/L	5.61	30.0

[redacted] W Liquid Aqueous **EPA 160.1**

Blank

Parameter	Type	Result	Unit
Total Dissolved Solids	Blank	-0.00010	grams

Duplicate

Parameter	Sample	Type	Result	Duplicate	Unit	RPD	Limit%
Total Dissolved Solids	831467	Duplicate	102	101	mg/L	0.985	25

LCS

Parameter	Type	Result	Known	Unit	Recover%	
Total Dissolved Solids	W11947 LCS	202	200	mg/L	101	75 - 125

Standard

Parameter	Type	Result	Known	Unit	Recover%	Limits%
Total Dissolved Solids	Standard	106	100	mg/L	106	90 - 110

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Quality Control

[redacted] W Liquid Aqueous EPA 160.1

Blank

Parameter	Type	Result	Unit
Total Dissolved Solids	Blank	0.00010	grams
Total Dissolved Solids	Blank	0.00030	grams

Duplicate

Parameter	Sample	Type	Result	Duplicate	Unit	RPD	Limit%
Total Dissolved Solids	831758	Duplicate	304	302	mg/L	0.660	25

LCS

Parameter		Type	Result	Known	Unit	Recover%	
Total Dissolved Solids	W11947	LCS	192	200	mg/L	96.0	75 - 125
Total Dissolved Solids	W11947	LCS	196	200	mg/L	98.0	75 - 125

Standard

Parameter	Type	Result	Known	Unit	Recover%	Limits%
Dissolved Solids	Standard	94.0	100	mg/L	94.0	90 - 110

RPD is Relative Percent Difference: abs(r1-r2) / mean(r1,r2) * 100%

Recover% is Recovery Percent: result / known * 100%

ADEQ data from "TMDL Investigation of Water Quality Impairments to Unnamed Tributary to Flat Creek Union County, Arkansas", April 1998.

Salt Creek @ O'rear Road			
Date	**Cl^- (mg/L)**	**SO_4 (mg/L)**	**TDS (mg/L)**
1/24/1995	170.1	10.6	780
3/21/1995	594	7.4	1136
4/4/1995	876	1.0	1724
9/5/1995	2970	2.3	5231
1/8/1996	1020	11.6	1704
2/6/1996	1040	7.6	1681
3/26/1996	650	5.4	1114
4/30/1996	642	8	871
5/28/96	1160	3.4	2242
6/18/96	1340	7.5	2714
7/16/1996	1130	5.9	1961

ECOREGION NUMBERS (Cl, SO4, &TDS): 14 mg/L, 31 mg/L, & 123 mg/L

Appendix F
Photos of Study Reaches

1. Confluence of UTB (right of picture) and UTC (left of picture) during seasonal flows. Note difference in color of two inflows. Flow on left of picture from UTC watershed. Flow from right discharge from EDCC 001.

4. UTB-1 View of UTB upstream of UTC. Summer low flow without 001 discharge flows.

2. Confluence of UTB and UTC, summer low flow period.

5. UTB-1. View of UTB during low flow period, very narrow channel width. Note exposed channel bottom. No flow.

3. UTB-1. View of UTB upstream of UTC. Seasonal discharge 001 flow.

6. UTB-2 Reach UTB view downstream of confluence with UTC. Seasonal flow.

7. UTB-2 Reach of UTB downstream of confluence with UTC. Low flow conditions. Note minimal flow and very shallow pools.

10. UTA-2 Study reach, seasonal period view upstream to Hwy 7S Bridge. Note water level mid-way of pipe crossing creek.

8. UTA-1 Reach UTA-1 from bridge view upstream. Seasonal conditions.

11. UTA-2 Study reach, summer low flow period. Note reduced water level below pipeline crossing.

9. UTA-1 Reach UTA-1 view downstream from bridge. Note algae growth along stream margins. Location upstream of EDCC discharge.

12. UTA-2 Study reach view downstream, measuring cross sectional habitat. Note stream width and exposed left descending bank.

13. UTA-2 Study reach, view downstream during low flow conditions. Note exposed left descending bank and habitat composition.

16. UTA-3. Study reach, seasonal period flow conditions. View to O'rear Road Bridge. Note water level from bank to bank.

14. UTA-2 Documentation of habitat quality. Note extensive buildup of sediment (sand) and shallow water within Reach UTB-2.

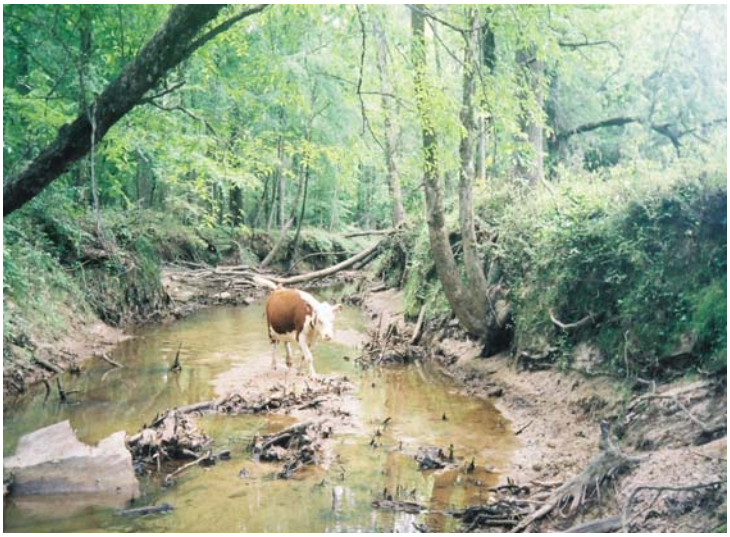
17. UTA-3 Study reach, low flow conditions. View d/s to O'rear Road Bridge. Note exposed banks and instream woody debris.

15. UTA-2 Railroad trestle at downstream end of UTA-2 reach. Note flow during spring seasonal period and buildup of woody debris along pipeline.

18. UTA-3 Study reach, view upstream seasonal period. Note stream banks. No exposed debris.

19. UTA-3 Study reach view upstream, low flow period note exposed woody debris and reduced stream channel.

22. FC-1 Reach FC-1. View upstream of reach. Note flow during seasonal period.



20. UTA-3 View upstream mid reach of UTA-3. Note agricultural use.

23. FC-1 Reach FC-1. View downstream of reach. Note shallow pool with abundant woody habitat.

21. UTA-3 Documentation of fish community assemblage in reach UTA-3. Note shallow pool conditions except at root balls and under at banks.

24. Flat Creek-2 (FC-2) Study reach. Note woody fish habitat and deep pools seasonal period.

25. Flat Creek-2 (FC-2) Study reach. Note exposed woody debris summer low flow period.

26. FC-2 Documentation of fish community assemblage in Reach FC-2. Note channel development and pool depth during spring seasonal condition.