PAINT ROCK RIVER WATERSHED
NONPOINT SOURCE ASSESSMENT

Final Report
November 17, 2000

Environmental Indicators Section
Field Operations Division
Alabama Department of Environmental Management

EXECUTIVE SUMMARY

Results of ADEM's Paint Rock River nonpoint source monitoring program indicate adverse impacts to water quality caused by nutrient enrichment, corroborating results of similar studies (GSA 1997). Elevated concentrations of ammonia (>0.05mg/L, Cole Springs Creek and Lick Fork), nitrite/ nitrate (>1.5 mg/L, Cole Springs), and total phosphorus (Cole Springs Creek, Little Paint Creek, Little Paint Rock Creek, and Paint Rock River) were found throughout the Lower Paint Rock River subwatersheds where concentrations of agriculture, cropland, and rates of sediment loss are highest (SWCD 1998). Results of ADEM's study also indicated concentrations of ammonia and total phosphorus to be periodically elevated in the upper and mid-Paint Rock River sub-watersheds (ammonia: Estill Fork, Guess Creek, Little Paint Rock, and Paint Rock; total phosphorus: Clear Creek, Dry Creek, Estill Fork, Guess Creek, Larkin Fork, and Lick Fork). Although relatively unimpaired (GSA 1997), these subwatersheds may be susceptible to water quality impairment from non-point source runoff.

At Little Paint Rock, average fecal coliform bacteria counts exceeded 1000 colonies/ 100mL over the 3-year study. Additional monitoring may be warranted to determine if bacterial counts exceed the limits established for the Fish and Wildlife Use Classification (monthly geometric mean of >1000 colonies/ 100mL water). Samples with >1,000 colonies of fecal coliform bacteria/ 100mL water were collected at Clear Creek, Cole Springs Creek, Dry Creek, Guess Creek, Larkin Fork, and Paint Rock River. Biological oxygen demand was elevated at Little Paint Rock Creek, Cole Springs Creek, and Paint Rock River.

The pesticides, Atrazine and Metolachlor, were detected at Dry Creek, Cole Springs Creek, and Lick Fork. Atrazine was detected at Paint Rock River. Di (2-ethylhexyl) phthalate, an inert ingredient found in many pesticides (Larson et al. 1997), was detected at all stations, suggesting historical pesticide use. Di (2-ethylhexyl) adipate, a common ingredient in making plastics (Larson et al. 1997), was detected at Estill Fork, Clear Creek, and Little Paint Rock Creek.

In 1998, macroinvertebrate assessments generally indicated Hurricane Creek, Dry Creek, Larkin Fork, and Lick Fork to be in excellent condition. Estill Fork, Guess Creek, and Clear Creek were assessed as good/ excellent. The macroinvertebrate communities of Little Paint and Little Paint Rock Creeks were in good condition. Cole Springs Creek was in fair/ poor condition. Fish IBI assessments evaluated Cole Springs Branch, Larkin Fork, Estill Fork, and Hurricane Creek similarly (TVA 1997). At all other stations, fish IBI assessments generally indicated higher degree of impairment than macro-invertebrates. This may be due to greater sensitivity of fish to sedimentation or different flow conditions between the 1997 fish assessment and the 1998 macroinvertebrate assessment.

Macroinvertebrate assessments were conducted again in 1999. At most stations, taxa richness measures were lower than they had been in 1998. However, flows in 1999 were only one-third to one-fourth of those measured during the 1998 assessment. Decreased flows may have limited habitat diversity and resulted in lower taxa richness.

Since 1993, best management practices (BMPs) have been implemented in 10 areas throughout the Paint Rock River watershed to control non-point source runoff (Figure 1). It is difficult to evaluate the impact of these measures on water quality due to the relatively short study period, divergent flow conditions between years, the relatively

limited number of BMPs that have been implemented, and the location of sampling sites in relation to the BMPs.

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INTRODUCTION

The Paint Rock River watershed encompasses approximately 450 mi^2 in Jackson, Marshall, and Madison Counties, Alabama, and Franklin County, Tennessee. Paint Rock River is one of the most biologically diverse river systems remaining in the southeastern United States, supporting 98 fish species (Mettee et al. 1997), 45 mussel species (Ortmann 1925, Isom and Yokley 1973, Ahlstedt 1986, Ahlstedt 1991, McGregor and Shelton 1995), and 11 freshwater turtle species (Conant and Collins 1991, Mount 1975).

However, previous studies in the watershed have found nonpoint source (NPS) pollutants contributing to water quality impairment and threatening biological diversity in the watershed (Ahlstedt 1991, Godwin 1995, O'Neil and Mettee 1997). Two fish and four mussels are currently on the federal threatened or endangered species list; two of these mussels are endemic to the Paint Rock River system (USFWS 1984, USFWS 1985). Channelization and removal of instream and riparian habitat have also been identified as concerns (Ahlstedt 1991, Godwin 1995). Consequently, the Paint Rock River system is listed as a state priority watershed in ADEM's NPS Assessment Report (ADEM 1989). Due to its rich and fragile diversity, it is also one of the few rivers in the country that is a focus of The Nature Conservancy's Freshwater Initiative.

Little Paint Rock Creek, Guess Creek, and Cole Springs Branch were added to Alabama's 303(d) list of streams currently not supporting their water use classifications due to siltation, organic enrichment, and dissolved oxygen violations from agricultural sources (ADEM 1998).

To restore water quality and ecological health in the watershed, the Paint Rock River Watershed Project was initiated in 1995 as a multi-year coordinated effort among federal, state, and local agencies, state and local interest groups, and landowners. The objectives of the project were to reduce NPS water quality impacts to protect natural resources through public awareness and participation and to improve water quality in the watershed to protect human health and aquatic life using best management practices.

In 1997, a basin-wide monitoring program was developed by the Environmental Indicators Section of Field Operations Division to assess the ecological integrity of the watershed prior to the implementation of BMP's and to demonstrate the effectiveness of these measures on water quality. Baseline chemical, physical, and biological data were collected at 11 stations, July 1997-January 2000. The objectives of the monitoring program were to:

1) document existing water quality of the Paint Rock River watershed;

2) provide baseline chemical and biological data to assess trends in water quality; and,

3) evaluate the effectiveness of cumulative BMP's as they are implemented.

MATERIALS AND METHODS

Study Area

The headwaters of the Paint Rock River system originate in Franklin County, Tennessee, and flow south-southwest until its confluence with the Tennessee River (Wheeler Reservoir). Upland tributaries are typically high gradient while the main channel near the mouth is slow moving and controlled by pool-level fluctuations in the reservoir. The watershed is located in the Plateau Escarpment

of the Southwestern Appalachians (68c) and the Eastern Highland Rim of the Interior Plateau (71g) subecoregions.

The Plateau Escarpment (68c) is characterized by high gradient, high velocity streams draining relatively steep, forested mountainsides; substrates are comprised of sandstone, limestone, shale, and siltstone. Natural vegetation is primarily mixed oak-forest on the upper slopes and mixed mesophytic forest and minor cropland and pasture in the lower slopes and stream bottoms.

The Eastern Highland Rim (71g) is characterized by flat to gently rolling hills and irregular plains; streams are low to moderate gradient with gravel and bedrock substrates of limestone, shale, and sandy clay (Griffin pers. comm. 1999). Lower gradient streams in the southern third of the watershed have sand-silt-cobble substrates, are generally turbid year-round, and have occasional flooding problems. Natural vegetation is mostly oak-hickory forest. Landuse is primarily agricultural. It has numerous springs originating from the underlying limestone. Elevation ranges from 450-950' above sea level (asl).

Landuse, Sedimentation Rates and Animal Population Estimates

Land-use information was obtained from EPA published estimates of percent land cover for the entire southeastern U.S. (EPA 1997a). These estimates were based on leaves-off Landsat TM data acquired in 1988, 1990, 1991, 1992, and 1993. Although the images used to estimate land cover were slightly dated, they provide generalized and consistent estimates for the entire basin. Therefore, they were used in conjunction with the results of a nonpoint source survey

(Godwin 1995) to locate 10 tributary and 1 mainstem station in agricultural areas suspected of adversely impacting the river system (Figure 1).

In 1998, the Alabama Soil and Water Conservation Committee (ASWCC) and the Soil and Water Conservation Districts estimated land-use percentages, animal concentrations, and sedimentation rates in each of the sub-watersheds statewide (SWCD 1998). In 1999, this information was used by ADEM to evaluate the potential for nonpoint source impairment within each subwatershed and cataloging unit within the Tennessee basin (ADEM 1999). Each subwatershed was ranked as L(ow), M(edium), or H(igh) based on the potential for nonpoint source impairment relative to the values obtained throughout the Tennessee basin (ADEM 1999). Land-use percentages, animal concentrations, and sedimentation rates for each of the Paint Rock River sub-watersheds are included with the results obtained during this monitoring program.

Water Quality Assessments

Grab samples were collected and analyzed for concentrations of nutrients and suspended solids at each of the 11 sampling sites monthly, July 1997- June 1998, and quarterly, August 1998- January 2000 (Table 1). Surface water was also collected for pesticide/herbicide analysis during the months of October (1997-1999), May (1998-1999), and June (1998, 1999) to coincide with seasonal application of these chemicals. Parameters analyzed by ADEM's Central Laboratory are listed in Table 2.

Nutrient concentrations measured during this study were evaluated with guidelines used previously within the basin (O'Neil and Mettee 1997). These values included 0.15 mg/L total phosphate, 1.5 mg/L nitrate/ nitrite, 0.05 mg/L ammonia, and

0.5 mg/L total Kjeldahl nitrogen and generally corresponded to the 90 to 95th percentile of values measured during ADEM's 3-year investigation.

Water temperature, pH, specific conductance and dissolved oxygen were measured *in situ* with a Hydrolab^{TM} Surveyor IV Multiprobe or with appropriate individual meters. Turbidity was measured with a turbidimeter. Stream discharge was estimated by measuring stream velocity at six to ten intervals in an abbreviated cross-sectional area method (ADEM 1996).

Duplicate field parameters and water samples were collected at 10% of the sampling events for Quality Assurance/ Quality Control purposes.

Habitat Assessments

The characterization of in-stream habitat quality is necessary for appropriate interpretation of biological community data (Barbour and Stribling 1994). During the Paint Rock watershed study, habitat quality was visually assessed and rated at each sampling site using riffle/run or glide/pool habitat assessment forms developed by the USEPA (Barbour and Stribling 1994). The riffle/run and glide/pool habitat assessment forms evaluate different parameters. However, both assessments are structured to rate three main habitat characteristics: instream characteristics (habitat availability and variability, degree of sediment deposition, loss of habitat, and channel morphology), bank and vegetative stability, and riparian zone measurements. Eleven (glide/pool) or 12 (riffle/ run) parameters are visually assessed for a maximum score of 220 or 240, respectively. The result of the assessment is a numerical score used to assess the stream habitat quality as excellent, good, fair or poor.

Macroinvertebrate Assessments

ADEM's multihabitat bioassessment was used to assess the condition of aquatic macroinvertebrate communities at wadeable sites during April 1998 and May 1999 (ADEM 1996). Benthic macroinvertebrates were collected from riffles, leaf packs or course particulate organic matter (CPOM), rocks and/or logs, undercut banks, sand and macrophytes. The samples collected from each habitat were preserved separately and returned to the laboratory for processing and generic-level identification.

Three metrics were used to evaluate the condition of the macroinvertebrate community at each site (see below). Metric results were compared to results from least-impaired ecoregional reference stations. A designation of excellent, good, fair or poor was assigned to each station.

TOTAL TAXA RICHNESS: Total taxa richness is the number of different kinds of organisms (genera) collected during a sampling event. Although low concentrations of nutrient enrichment can increase taxa richness (Welch 1992), taxa richness generally increases with improving water quality (Barbour et al. 1999).

EPT TAXA RICHNESS: This is the portion of taxa richness that includes three pollution-intolerant groups: mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera). EPT taxa richness generally increases with increasing water quality, although there are some EPT taxa that thrive in slightly enriched waters (Lenat 1993).

NC BIOTIC INDEX (NCBI): The NC Biotic Index ranges from 0 to 10. The larger the number, the poorer the water quality. The tolerance values used by ADEM were

developed by North Carolina (Lenat 1993) and summarize the overall pollution tolerance of the macroinvertebrate community with a single value.

Chain of Custody

Biological and chemical samples were preserved and transported with appropriate chain of custody in accordance with methods outlined in ADEM Field Operations Standard Operating Procedures and Quality Control Assurance Manual, Volume I - Physical/Chemical (1994) and Volume II – Freshwater Macroinvertebrate Biological Assessment (1996).

RESULTS

Estill Fork Subwatershed (0603-0002-020)

The Estill Fork subwatershed drains 59 mi^2 of the Upper Paint Rock subwatershed (Figure 1). The subwatershed is primarily forested (92%), with smaller areas of cropland (6%) and pasture (1%) (SWCD 1998). Although potential for NPS impairment within the subwatershed is relatively low (ADEM 1999), biological surveys have indicated the subwatershed to support an unusually high diversity of mussels, fish, and turtles, including several rare and endangered species. Therefore, one site was established on each of its two main tributaries, Estill Fork (ESTL-1) and Hurricane Creek (HURR-1).

Average nutrient concentrations measured at ESTL-1 were generally low during the three-year study (Table 3a). However, ammonia (NH_3), total Kjeldahl nitrogen (TKN), and fecal coliform counts were periodically elevated. Di (2-Ethylhexyl) phthalate and di (2-Ethylhexyl) adipate were also detected.

Average nutrient concentrations measured at HURR-1 were also relatively low during the three-year study (Table 3a). However, total phosphorus (TP), total Kjedahl nitrogen concentrations (TKN), and fecal coliform bacteria counts were elevated periodically (Appendix A). Di (2-Ethylhexyl) phthalate was detected in the May and June 1998 samples (Appendix B).

ESTL-1 is characterized by boulder-cobble-gravel substrates and estimates were relatively consistent between 1998 and 1999. Habitat quality was assessed as "good" (Table 4); the primary impairment to habitat quality was due to a lack of bank vegetative protection and a narrow riparian buffer zone. In 1997, trees were planted along the bank at the site to control erosion. Taxa richness measures were relatively similar at the site during 1998 and 1999 (Table 5) and indicated the macroinvertebrate communities to be in good condition.

Substrate characterization at HURR-1 differed between the two years due to a change in sampling reach in 1999. In 1998, Hurricane Creek was sampled directly above the concrete ford. Sand comprised 70% of available substrate, suggesting that the ford is creating a depositional area that retains sediment and organic matter that would normally be carried downstream during high flow events. Stream reaches above and below the ford are characterized primarily cobble-gravel substrates, suggesting that the ford affects a very small area directly upstream. In addition, stream flows measured in 1999 were one-third those measured in 1998 (Table 3b). Taxa richness measures in 1998 rated the site as "good/ excellent" (Table 5). In 1999, EPT taxa richness and total taxa richness were approximately one-half and two-thirds the values measured the previous year and

rated the site as "good/ fair" (Table 5). The difference between scores may be due to decreased habitat heterogeneity caused by low flow conditions in 1999.

Larkin Fork (0603-0002-040)

The Larkin Fork subwatershed drains 32 mi^2 of the Upper Paint Rock River subwatershed (Figure 1). The subwatershed is primarily forested (93%), with a small percentage of pastureland (6%). Potential for NPS impairment within the subwatershed was ranked as relatively low for the Tennessee basin (ADEM 1999).

Nutrient concentrations measured at LARK-1 were relatively low during the three-year study (Table 3a). However, nutrient concentrations (ammonia, total Kjedahl nitrogen, total phospohorus) and fecal coliform counts were elevated in July and October 1997 and again in May and June 1998, indicating periods of nutrient enrichment (Appendix A). Runoff from pastures directly adjacent to the creek is a probable source of excess nutrients. Di (2-Ethylhexyl) phthalate was detected in the May and June 1998 pesticide sample (Appendix B).

Cobble, gravel, and sand characterized bottom substrates at LARK-1. In 1998, habitat availability and quality at LARK-1 scored 175 and rated an assessment of "excellent" (73% of maximum) (Table 4). In 1999, habitat quality was scored 140 (58%) and rated as "fair/good". The lower score in 1999 was primarily a consequence of low flow conditions that exposed stream substrates and reduced habitat heterogeneity.

In 1998, the macroinvertebrate community was assessed as "excellent/good" based on taxa richness and NCBI metrics (Table 5). Taxa richness was much lower and the NCBI higher in 1999 and rated the site as "fair". This may also be attributed to increased sediment deposition and lower habitat diversity caused by low flows.

Lick Fork (0603-0002-050)

The Lick Fork subwatershed drains approximately 70 m^2 of the Upper Paint Rock River watershed (Figure x). The subwatershed is primarily forested (91%), with a small percentage of pasture (3%) and crops (5%). Potential for NPS impairment within the subwatershed was ranked relatively low for the Tennessee basin (ADEM 1999). One assessment site was located on each of its two main tributaries, Lick Fork (LICK-1) and Dry Creek (DRYJ-1) (Table 1, Figure 1).

Nutrient concentrations measured at LICK-1 were relatively low during the three-year study (Table 3a). However, nutrient concentrations (ammonia, total phosphorus, and total Kjedahl nitrogen) were relatively high during July 1997 to September 1997 (Appendix A). Fecal coliform counts were slightly elevated in September 1997 and again during the summer months of May, June, and August 1998. Di (2-Ethylhexyl) phthalate and the herbicides atrazine, metolachlor, and pendimethalin were detected in June 1998 (Appendix B). Pasture activities in the watershed could be responsible for the elevated nutrient concentrations.

In 1998, bottom substrates were composed primarily of gravel and sand. Habitat availability and quality scored 190 (79% of 240 maximum points) and rated as excellent (Table 4). In 1999, percent sand was lower in 1999 as flow decreased and exposed these substrates as sandbars. Habitat quality was assessed as excellent, but scored slightly lower due to a loss of habitat diversity caused by low flow conditions.

In 1998, taxa richness and community tolerance measures indicated the macroinvertebrate community to be in “excellent” condition (Table 5). However, total

taxa richness and EPT taxa richness were lower in 1999 than in 1998 due to the loss of habitat associated with the low flow conditions.

Nutrients concentrations measured at DRYJ-1 were relatively low during the three-year study (Table 3a). However, total Kjedahl nitrogen concentrations were elevated in July 1997(0.354 mg/L) and October 1997(0.505 mg/L) and January 1999 (0.306 mg/L) (Appendix A). The January 1999 sample was collected during high flow conditions possibly contributing to the elevated results (Appendix A). Fecal coliform counts were relatively high in July, August, and September 1997 (390 to 1020 colonies/ 100 ml) and May, June, and August 1998 (280 to 460 colonies/ 100 ml). Concentrations of Di (2-Ethylhexyl) phthalate above the detection limit of 0.1 mg/L were found in the May and June 1998 sample (Appendix B). Low concentrations of the herbicide metolachlor (May 1998) and atrazine (June 1998) were also detected.

Bottom substrates were composed of boulder, cobble, gravel, and sand during in 1998 and 1999. However, percent sand was higher in 1998 than in 1999 due to lower flows. Sand that was included in percent substrate composition in 1998 was exposed as sandbars in 1999. During both years, habitat quality for the site was assessed as "good/ excellent" with scores ranging from 61-65% of maximum (Table 4). Taxa richness and community tolerance measures indicated the macroinvertebrate community to be in excellent condition during both 1998 and 1999 (Table 5).

Guess Creek (0603-0002-060)

The Guess Creek subwatershed (060) drains approximately 34 mi^2 of the middle Paint Rock subwatershed (Figure 1). The subwatershed is primarily forest (83%) and pasture (14%) and a small percentage of cropland (2%) (SWCD 1998). The potential for

NPS impairment was assessed as relatively low for the Tennessee basin (ADEM 1999). A segment of Guess Creek is currently listed on Alabama's 1998 303(d) list of streams not meeting their water use classification requirements. Sources of impairment to Guess Creek have been identified as pathogens, unknown toxicity, and organic enrichment/dissolved oxygen impairment (ADEM 1998).

Guess Creek is spring-fed and was therefore distinguished from other stations in the watershed by relatively low water temperatures, conductivity, alkalinity and hardness. Nutrient concentrations were also relatively low but were elevated during September-October 1997 and June 1998 (Appendix A). Fecal coliform counts were high during May-September 1997 (>260 colonies/100 ml), May-August 1998 (296 to 800 colonies/100 ml), and August 1999 (980 colonies/ 100 ml). Dissolved oxygen in September 1997 at 4.4 mg/L and in August 1999 at 3.7mg/L were lower than the Fish and Wildlife water quality standard of 5.0 mg/L. Di (2-Ethylhexyl) phthalate was detected in the May and June 1998 samples (Appendix B).

Bottom substrates at GUES-1 were composed of gravel, sand/silt, and organic detritus. Habitat assessments indicated habitat quality was "good/ excellent" (60-68% of maximum score) (Table 4). Evaluation of the aquatic macroinvertebrate community was not as clear. Total taxa richness increased from 33 taxa in 1998 to 44 taxa in 1999 (Table 5). However, most of the increase was due to an increase in chironomid taxa richness. Taxa richness of pollution-sensitive EPT taxa decreased from 12 in 1998 to 8 in 1999 (Table 5). The macroinvertebrate community was therefore assessed to be in "excellent/ good" condition in 1998 and "fair" condition in 1999.

Cole Springs Branch (0603-0002-070)

The Upper Paint Rock River sub-watershed, located in the mid Paint Rock watershed, has a drainage area of approximately 52 mi^2. Percent land use was estimated as 83% forest, 10% row crops, 5% pasture/ hay, and 1% urban (Table 2 and Figure 2). Pasture and row crops were observed to be the primary land use activities upstream of the sampling point. Potential for nonpoint source impairment was rated as moderate due to relatively high rates of sediment erosion from 'critical areas' (SWCD 1998, ADEM 1999). A segment of Cole Springs Branch is currently listed on Alabama's 1998 303(d) list of streams not meeting their water use classification requirements due to siltation and organic enrichment/dissolved oxygen impairment (ADEM 1998).

CSPR-1 was characterized by the highest concentrations of ammonia, nitrate/nitrite, and total phosphorus in the Paint Rock watershed (Table 3a). Fecal coliform counts and biological oxygen demand were also highest at this station (Table 3a). However, these elevated concentrations resulted from one sample collected in April 1999, in which concentrations of ammonia (11.834 mg/L), total Kjedahl nitrogen (39.4 mg/L), and total phosphorus (4.584 mg/L) were extremely high (Appendix A). Biochemical oxygen demand (>156 mg/L) was also extremely high during this sampling event. Dissolved oxygen (2.5 mg/L) and turbidity (447 ntu) violated water quality standards for a Fish and Wildlife classification.

However, if results from this sampling event are not included in the analyses, Cole Springs is still characterized by the highest fecal coliform bacteria counts, biological oxygen demand, and nitrate/nitrite concentrations, and among the highest concentrations of ammonia, total dissolved solids, total suspended solids, and total phosphorus. Di (2-

Ethylhexyl) phthalate was detected in May and June 1998 (Appendix B). The herbicide atrazine was detected in the June 1998 (0.168 mg/L) and in the May 1999 (0.814 mg/L).

Sand comprised 65% of the substrate at CSPR-1. Habitat quality was estimated to be "fair" in both 1998 and 1999, due to unstable banks, a lack of riparian buffer, and a lack of instream habitat (Table 4).

Measures of taxa richness were higher in 1998 than in 1999. Total taxa richness decreased from 32 to 20; EPT taxa richness decreased from 4 to 0, indicating the site to be in "fair/ poor" condition in 1998 and "poor" condition in 1999 (Table 5). NC biotic index values increased from 7.3 in 1998 to 8.1 in 1999.

Clear Creek (0603-0002-080)

The Clear Creek subwatershed drains 20 mi^2 of the mid Paint Rock River subwatershed. The subwatershed is primarily forested (85%) with small areas of pasture (12%). Potential for nonpoint source impairment was rated as low (SWCD 1998).

Nutrient concentrations were relatively low at CLER-1 during the three-year study (Table 3a). However, water quality sampling did detect elevated counts of fecal coliform and periodic nutient enrichment (Appendix A). Nutrient concentrations (total Kjedahl nitrogen and total phosphorus), turbidity, total suspended solids, and fecal coliform bacteria were elevated in July and September 1997. Nitrate/nitrite concentrations were increased in March 1998 (0.452 mg/L) and in January 1999 (0.508 mg/L) possibly due to increased flow from rainfall for several days prior to sample collection. Elevated concentrations of total phosphate (0.106 mg/L) were detected during August 1998

(Appendix A). Di (2-Ethylhexyl) phthalate and Di (2-Ethylhexyl) adipate were detected at this site (Appendix B).

The bottom substrate of CLER-1 is primarily composed of gravel, cobble, and sand. The habitat quality of Clear Creek was assessed as "excellent" with scores ranging from 65-68% of maximum (Table 4).

Assessment of the aquatic macroinvertebrate communities indicated the site to be in "good" condition with 12 Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa collected in 1998. In 1999, taxa richness measures were lower and indicated the site to be in "fair" condition. (Table 5)

Little Paint Creek (0603-0002-090)

The Little Paint Creek subwatershed (090) drains approximately 179 mi^2 of the Lower Paint Rock watershed (figure 1). Landuse within the subwatershed was estimated as 61% forest, 19% pasture, 14% cropland, 3% open water, 2% urban, and 1% other (SWCD 1998). Although concentrations of cattle were moderate (ADEM 1999), the overall potential for impairment for nonpoint sources was rated as low (SWCD 1998, ADEM 1999). A two mile segment of Little Paint Creek is currently included on ADEM's 1998 303(d) list of streams not meeting the criteria associated with its water quality use classification.

Water quality assessments indicated periodic elevations in nutrients and fecal coliform bacteria (Appendix A). Ammonia, total Kjedahl nitrogen, and total phosphate concentrations were relatively high in July-November 1997 and again in August 1998. Fecal coliform counts in September 1997 were 700 colonies/100 ml. The increased nutrient concentrations could correspond to the times of the year that the cattle are grazed

in the pastures directly adjacent to the creek at the sampling site. Di (2-Ethylhexyl) phthalate was detected in May and June 1998 (Appendix B).

Bottom substrates at LPNT-1 were characterized by bedrock and sand mixed with boulder, cobble, and gravel. The habitat quality was evaluated as "excellent" in both 1998 and 1999, with scores ranging from 74% to 68% of the total maximum score (Table 4). Taxa richness measures were relatively constant between 1998 and 1999 and indicated the site to be in "good" condition (Table 5).

Lower Paint Rock River (0603-0002-100)

The Lower Paint Rock River subwatershed comprises a very small drainage of the Paint Rock River basin (1 mi^2). Landuse within the subwatershed was estimated as 52% forest, 17% cropland, 24% pasture, 2% urban, and 4% open water (SWCD 1998). A segment of Little Paint Rock Creek is currently listed on Alabama's 1998 303(d) list of streams not meeting their water use classification requirements due to siltation and organic enrichment/dissolved oxygen impairment (ADEM 1998). Potential for nonpoint source impairment from cattle and sedimentation was rated as "moderate" by ADEM based on information provided by the SWCD (1998). Macroinvertebrate and chemical assessments were conducted on Little Paint Rock Creek (LPRK-1) and the mainstem of Paint Rock River (PTRK-1).

Water samples collected at LPRK-1 indicated elevated fecal coliform counts, total phosphate and total Kjedahl nitrogen concentrations during the months of July-October 1997 (Appendix A). Turbidity was relatively high in July 1997 (69 ntu), May 1998 (92 ntu) and June 1998 (315 ntu). Fecal coliform counts for the months of May and June 1998 and April 1999 were too-numerous-to-count (TNTC) in a 100-ml sample.

Dissolved oxygen concentrations of 4.9 mg/L and turbidity levels of 315 ntu in June 1998 fell below the Fish and Wildlife water quality standards of 5.0 mg/L (dissolved oxygen) and 50 ntu above background (turbidity). Di (2-Ethylhexyl) phthalate was detected May and June 1998 and Di (2-Ethylhexyl) adipate was detected May 1998 (Appendix B).

The substrate was composed primarily of gravel, silt, and clay. The in-stream habitat was assessed as "poor/ fair" during the habitat assessments in 1998 and 1999 due to a lack of stable in-stream habitat and poor bank condition (Table 4). Taxa richness measures and the NC biotic index indicated the macroinvertebrate community to be in "good" condition in 1998 and "fair" condition in 1999 (Table 5).

The Paint Rock River covers 74.1 stream miles and flows through Marshall, Jackson, and Madison Counties. Ammonia was detected in September and October 1997 and October 1998 during low flow conditions. Total Kjedahl nitrogen concentrations ranging from 0.116 mg/L to 1.309 mg/L were elevated when compared to individual stations within the Paint Rock watershed. Total phosphorus concentrations ranged from less than detectable limits to 0.442 mg/L. Dissolved oxygen concentrations fell to 4.5 mg/L in August 1998 at low flow conditions. (Appendix A)

CONCLUSIONS

Results of ADEM's Paint Rock River nonpoint source monitoring project indicate adverse impacts to water quality caused by nutrient enrichment, corroborating results of similar studies (O'Neil and Mettee 1997). Elevated concentrations of ammonia, nitrite/ nitrate, and total phosphorus were found throughout the Lower Paint Rock River subwatersheds where concentrations of agriculture, cropland, and rates of sediment loss are highest (SWCD 1998). Additionally, results of monthly sampling supported the

inclusion of Cole Springs Branch and Little Paint Rock River on ADEM's 303(d) list. Results of ADEM's study also indicated concentrations of ammonia and total phosphorus to be periodically elevated in the upper and mid-Paint Rock River sub-watersheds. Although relatively unimpaired (O'Neil and Mettee 1997), these subwatersheds may be susceptible to water quality impairment during high flow events.

In 1998, macroinvertebrate assessments generally indicated Hurricane Creek, Dry Creek, Larkin Fork, and Lick Fork to be in "excellent" condition. Estill Fork, Guess Creek, and Clear Creek were assessed as "good/ excellent". The macroinvertebrate communities of Little Paint and Little Paint Rock Creeks were in "good" condition. Cole Springs Creek was in "fair/ poor" condition. Cole Springs Branch, Larkin Fork, Estill Fork, and Hurricane Creek were assessed similarly using fish IBI assessments (TVA 1997). Fish IBI assessments generally indicated higher degree of impairment than macroinvertebrates at all other stations. This may be due to greater sensitivity of fish to sedimentation and/ or differing flow conditions between the 1997 fish assessment and the 1998 invertebrate assessment.

Macroinvertebrate assessments were conducted again in 1999. At most stations, taxa richness measures were lower than they had been in 1998. However, lower taxa richness was most likely a consequence of limited habitat diversity caused by low flow conditions during 1999.

One objective of ADEM's nonpoint source monitoring program is to evaluate the effectiveness of best management practices (BMPs) implemented within the watershed to control nonpoint source runoff. To date, 10 BMPs have been implemented throughout the Paint Rock River watershed, 5 of which are concentrated in the Little Paint Creek

subwatershed (Figure 1). However, it is difficult to evaluate the impact of these measures on water quality due to the relatively short study period, divergent flow conditions during the study period, the limited number of BMPs that have been implemented, and the location of sampling sites in relation to BMPs. Therefore, EIS recommends that the watershed be re-evaluated during the 2003 Tennessee basin assessment. Monthly monitoring of physical, chemical, and habitat parameters to include rate of sediment loss and percent bank vegetation at BMP, reference, and impaired sites. Macroinvertebrate and fish assessments should also be conducted.

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Table 1. Location and description of sampling stations in the Paint Rock River Nonpoint Source Monitoring Project.

Waterbody	Station	Latitude	Longitude	Description
Clear Creek	CLER-1	34.7193	-86.3108	AL Hwy 65 crossing, Jackson County (T4S/ R3E/ S4)
Cole Springs Branch	CSPR-1	34.6828	-86.3297	Hwy 65 crossing, Jackson County (T4S/ R3E/ S20)
Dry Creek	DRYJ-1	34.7923	-86.2521	AL Hwy 65 crossing, Jackson County (T3S/ R3E/ S12)
Estill Fork	ESTL-1	34.9653	-86.1537	Jackson County road 140 crossing (T1S/ R5E/ S6)
Guess Creek	GUES-1	34.7597	-86.1897	Near Jackson County road 20 (T3S/ R4E/ S27)
Hurricane Creek	HURR-1	34.9180	-86.1330	Jackson County road 141 east of McCullough cemetery (T1S/ R5E/ S31)
Larkin Fork	LARK-1	34.8656	-86.2082	Off AL Hwy 65 near Halls Chapel, Jackson County (T1S/ R4E/ S33)
Lick Fork	LICK-1	34.8524	-86.2438	Jackson County road 3 crossing (T2S/ R4E/ S19)
Little Paint Creek	LPNT-1	34.6013	-86.2695	Jackson County road 63 crossing (T5S/ R3E/ S13)
Little Paint Rock Creek	LPRK-1	34.4847	-86.3862	Unnamed Marshall County road crossing south of US Hwy 431 (T6S/ R2E/ S26)
Paint Rock River	PTRK-1	34.5179	-86.3855	Unnamed Marshall County road north of US Hwy 431, near New Hope (T6S/R2E/S14)

Table 2. Analytical methods used in the water quality assessment of the watershed.

Variable	Method	Reference
Sediment loading		
Total suspended solids	Filtration, drying	EPA 160.2
Total dissolved solids	Filtration, drying	EPA 160.1
Alkalinity	Potentiometric titration	EPA 310.1
Hardness	Titrametric, EDTA	EPA 130.2 (BHM)
Pesticides (detected)[a]		
Atrazine	Organics by gas chromatography	EPA 525.2
Metolachlor	Organics by gas chromatography	EPA 525.2
Di (2-Ethylhexyl) adipate	Organics by gas chromatography	EPA 525.2
Pendimethalin	Organics by gas chromatography	EPA 525.2
Bis (2-Ethylhexyl) phthalate	Organics by gas chromatography	EPA 525.2
di (2-Ethylhexyl) phthalate	Organics by gas chromatography	EPA 525.2
Nutrient concentrations		
Ammonia	Automated colorimetrc	EPA 350.1
Nitrate + Nitrite	Automated colorimetrc	EPA 353.2
Total Kjeldahl nitrogen	Automated colorimetric	EPA 351.2
Total phosphate	Persulfate digestion	EPA 365.4
Biological indicators		
Macroinvertebrates	Multihabitat bioassessment	ADEM 1996
Fecal coliform	Membrane filter	APHA et al. 1992

a. Pesticide analyses run, but not detected: Synthetic Organic Compounds (EPA 525.2): Benzo(a) pyrene, Butachlor, Chlorimuron ethyl, cis-Cypermethrin, Dieldrin, Endrin, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Methoxychlor, metolachlor, Metribuzin, Norflurazon, Pendimethlin, Propachlor, Simazine, Trifluralin; Carbamates by HPLC (EPA 531.1): 3-Hydroxycarbofuran, aldicarb, Aldicarb Sulfone, Aldicarb Sulfoxide, Carbaryl (Sevin), Carbofuran, Methomyl, Oxamyl, Glyphosphate; Phosphorus Pestices in Liquid (SW8141): Azinphos methyl, Diazinon, Ethion, Malathion, Mevinphos, Parathon ethyl, Parathion methyl; Herbicides in Liquid (SW 8151): 2,4,5-T, 2,4-D, Acifluoren-sodium, Bentazon, Silvex

Table 3a. Average nutrient concentrations, fecal coliform bacteria counts, and biological oxygen demand (±1 SD) measured during 1997-1999.

Station #	Ammonia mg/L	Nitrite/ nitrate mg/L	Total Kjedahl Nitrogen mg/L	Total phosphorus mg/l	Fecal coliform col/ 100ml	BOD-5 mg/L
CLER-1	<0.011±0.014	0.283±0.119	<0.235±0.165	<0.034±0.043	445±957	<1.4±1.1
CSPR-1	<0.676±2.785	<1.954±0.794	<2.443±9.228	<0.313±1.067	>684±500	10.4±36.5
DRYJ-1	<0.011±0.014	0.333±0.106	0.204±0.120	<0.022±0.023	328.4±227.7	<1.2±1.0
ESTL-1	<0.018±0.023	0.120±0.087	0.217±0.103	<0.018±0.018	110±144	<1.2±0.8
GUES-1	<0.016±0.023	0.288±0.136	<0.167±0.107	<0.024±0.029	317±365	<1.1±0.8
HURR-1	<0.011±0.014	0.123±0.058	<0.207±0.101	<0.017±0.017	143±160	<1.1±0.8
LARK-1	<0.013±0.015	0.311±0.226	0.231±0.125	<0.028±0.029	290±455	1.1±0.8
LICK-1	<0.012±0.016	0.307±0.101	<0.186±0.119	<0.022±0.024	197±195	<1.1±1.1
LPNT-1	<0.013±0.015	0.472±0.310	<0.294±0.168	<0.054±0.051	180±174	1.3±0.8
LPRK-1	0.022±0.032	0.434±0.185	0.795±1.279	0.222±0.556	888±1434	2.0±2.1
PTRK-1	<0.022±0.029	0.415±0.175	0.398±0.293	<0.071±0.099	436±678	<1.5±1.5

Table 3b. Average values (`1 SD) of physical parameters measured during 1997-1999.

Station	Water Temp. °C	Flow cfs	D.O. mg/l	pH su	Conductivity umhos@ 25°C	Turbidity NTU	Total dissolved solids mg/L	Total suspended solids mg/L	Alkalinity mg/l	Hardness mg/l
CLER-1	16.8±5.9	15.7±28.7	9.7±1.6	7.8±0.3	244±49	9±14	149.8±26.8	<8.0±12.3	113±17	141±20
CSPR-1	16.5±4.3	12.1±17.2	7.6±1.9	7.4±0.3	314±72	36±97	202.9±66.2	28.8±47.3	133±21	167±23
DRYJ-1	16.1±5.4	28.5±39.2	8.8±1.7	7.7±0.2	234±54	6±4	142.7±26.3	<3.3±2.5	107±19	135±25
ESTL-1	16.6±6.0	25.1±28.9	8.9±1.9	7.8±0.2	303±62	3±2	187.4±27.4	<1.5±1.1	138±14	169±19
GUES-1	15.2±4.2	30.2±39.7	8.2±2.6	7.4±0.3	159±62	8±13	97.3±34.9	3.2±3.9	74±29	97±31
HURR-1	16.3±5.6	36.4±47.6	8.8±1.7	7.6±0.2	245±56	25±80	149.4±27.6	3.8±3.8	109±19	137±27
LARK-1	16.8±6.0	39.4±52.4	8.5±2.0	7.6±0.2	310±49	4±3	189.7±21.5	<2.8±2.2	144±14	175±20
LICK-1	15.9±5.3	23.5±26.8	9.1±1.9	7.6±0.2	233±49	5±5	143.5±25.0	<2.9±3.9	109±19	138±26
LPNT-1	17.1±5.9	15.3±20.9	9.0±1.8	7.6±0.2	271±58	12±11	169.4±22.1	9.8±10.7	122±18	151±19
LPRK-1	16.4±5.9	15.8±26.1	8.4±1.8	7.4±0.3	198±57	94±237	131.1±41.4	156.3±484.0	91±25	115±28
PTRK-1	15.6±6.0		8.0±1.8	7.5±0.2	239±58	45±124	151.6±21.4	26.7±61.7	106±22	131±26

Table 4. Habitat assessment data collected from July 1997-August 1999 as part of the Paint Rock Nonpoint Source Monitoring Project.

Station	Date *yymmdd*	Riffle/Run Score (240 maximum)	Glide/ Pool Score (220 maximum)	% Maximum Score
CLER-1	970722	122		51
CLER-1	970825		92	42
CLER-1	980428	157		65
CLER-1	981027	166		69
CLER-1	990125		160	73
CLER-1	990524	164		68
CLER-1	990824	147		61
CSPR-1	970723		94	43
CSPR-1	970825		107	49
CSPR-1	980428		121	55
CSPR-1	990125		147	67
CSPR-1	990524		103	47
DRYJ-1	970722	122		51
DRYJ-1	970825		110	50
DRYJ-1	980428	157		65
DRYJ-1	990125		164	75
DRYJ-1	990525		135	61
ESTL-1	970722		144	65
ESTL-1	970825		131	60
ESTL-1	980429	175		73
ESTL-1	990525		150	68
ESTL-1	990824		137	62
GUES-1	970723		136	62
GUES-1	970825		125	57
GUES-1	980428	154		64
GUES-1	990125		145	66
GUES-1	990524		150	68
GUES-1	990824		155	70
HURR-1	970722	129		54
HURR-1	970825		120	55
HURR-1	980429	130		54
HURR-1	990126		138	63
HURR-1	990525		128	58
HURR-1	990824		128	58

Table 4. Habitat assessment data collected from July 1997-August 1999 as part of the Paint Rock Nonpoint Source Monitoring Project.

Station	Date *yymmdd*	Riffle/Run total Score	Glide/ Pool Total Score	% 220 Point Maximum
LARK-1	970722	96		40
LARK-1	970825		159	72
LARK-1	980428	171		71
LARK-1	981027	173		72
LARK-1	990126		148	67
LARK-1	990525	140		58
LARK-1	990824	152		63
LICK-1	970722		120	55
LICK-1	970825		134	61
LICK-1	980428	195		81
LICK-1	990126		151	69
LICK-1	990525	172		72
LPNT-1	970723	190		79
LPNT-1	970825	170		71
LPNT-1	980428	177		74
LPNT-1	981027	171		71
LPNT-1	990526	163		68
LPNT-1	990825	154		64
LPRK-1	970722		96	44
LPRK-1	970825		71	32
LPRK-1	980428	137		57
LPRK-1	990127		100	45
LPRK-1	990526		86	39

Table 5. Metric results from macroinvertebrate data collected April 28, 1998 and May 24, 1999 as part of the Paint Rock Nonpoint Source Monitoring Project. An explanation of each metric is provided below.

	Taxa richness metrics						Community tolerance metric	
	Total[a]		EPT (family)[b]		EPT (genus)[c]		NCBI[d]	
Station	1998	1999	1998	1999	1998	1999	1998	1999
ESTL-1	45	42	11	9	14	12	4.3	5.1
HURR-1	51	35	15	8	20	9	4.2	5.7
LARK-1	52	36	13	6	15	6	4.3	5.5
DRYJ-1	54	38	14	10	18	12	4.4	4.7
LICK-1	59	48	16	12	20	13	4.4	4.3
GUES-1	33	44	11	7	12	8	4.0	6.4
CSPR-1	32	20	4	0	4	0	7.3	8.1
CLER-1	49	47	12	8	15	10	5.3	5.8
LPNT-1	50	50	11	12	13	13	5.5	5.5
LPRK-1	49	38	10	5	12	5	4.8	7.0

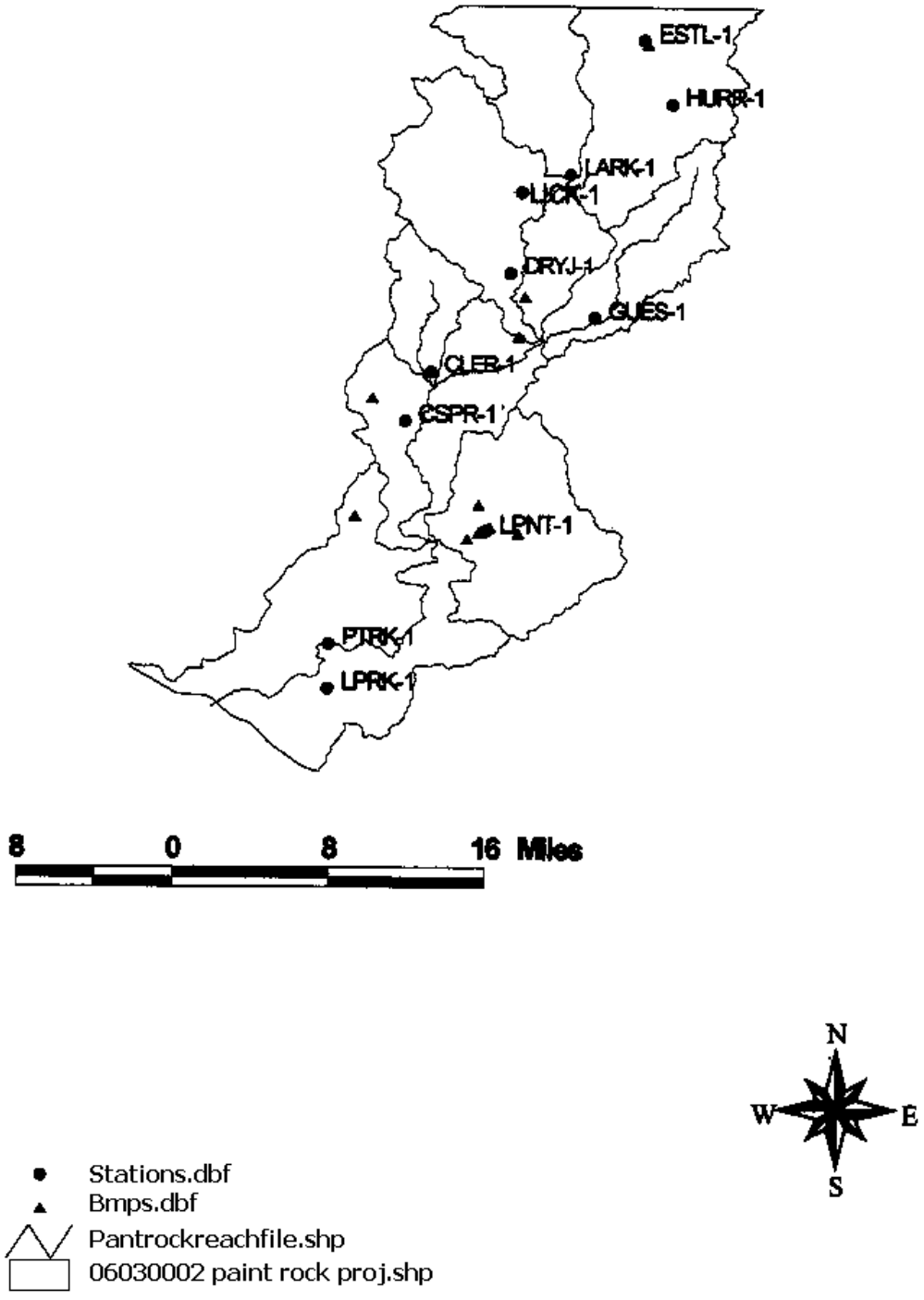
a. TOTAL TAXA RICHNESS: Total taxa richness is the number of different kinds of organisms (genera). Total taxa richness generally increases with improving water quality, although it can increase with low levels of nutrient enrichment.

b. EPT TAXA RICHNESS (genera): Number of genera collected in three pollution-intolerant groups: mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera). EPT taxa richness generally increases with increasing water quality, although there are some EPT taxa that thrive in slightly enriched waters.

c. EPT TAXA RICHNESS (family): Includes the number of pollution-intolerant mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) families. This metrc is generally used to screen sites for obvious impacts.

d. NC BIOTIC INDEX (NCBI): The NC Biotic Index summarizes the overall pollution tolerance of the macroinvertebrate community with a single value. It ranges from 0 (least-impaired) to 10 (most impaired).

Fig. 1. Stations and best management practices (BMPs) in Paint Rock River Basin



APPENDICES

Appendix A, Table 1. Results of physical / chemical samples collected from Estill Fork, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
020	Estill Fork	ESTL-1	971118	7	10.8	7.9	187	1		45	0.8	194	<1	<0.005	0.110	0.083	<0.005	148	184
020	Estill Fork	DUP001	971118	7	10.8	7.8	191	1		35	0.8	195	<1	<0.005	0.106	<0.05	<0.005	146	184
020	Estill Fork	ESTL-1	970722	30	6.9	7.8	346	2		384	0.9	206	<1	0.048	0.134	0.310	0.036	149	186
020	Estill Fork	ESTL-1	970825	21	5.5	7.6	267	2		30	2.5	210	3	<0.005	0.059	0.224	0.031	137	180
020	Estill Fork	ESTL-1	970924	21	5.8	7.6	329	3		350	2.7	187	<1	<0.05	0.063	0.246	0.034	129	174
020	Estill Fork	ESTL-1	971021	14	8.6	7.8	371	2	1.2	62	0.8	216	<1	**0.088**	0.028	0.431	<0.005	145	192
020	Estill Fork	ESTL-1	971216	9	11.9	7.6	332	1	14.4	12	<0.1	182	1	<0.005	0.116	0.284	<0.005	140	170
020	Estill Fork	ESTL-1	980205	9	10.6	7.9	240	5		63	1.1	136	<1	<0.05	0.157	0.052	<0.05	101	120
020	Estill Fork	ESTL-1	980225	14	11	7.8	234	2	40.7	0	1.2	166	1	<0.005	0.115	0.112	0.051	127	154
020	Estill Fork	ESTL-1	980324	14	10.6	8	286	3	73.4	2	0.4	169	<1	<0.005	0.101	0.162	<0.005	130	156
020	Estill Fork	ESTL-1	980429	13	9.2	8.3	297	2	20.3	480	0.5	171	<1	0.005	0.084	0.105	0.012	132	170
020	Estill Fork	ESTL-1	980526	23	7.8	7.8	346	3	1.3	88	1.2	206	<1	<0.005	0.153	0.128	<0.05	144	172
020	Estill Fork	ESTL-1	980622	21	9	7.9	313	5	14.5	228	1.1	181	1	<0.005	0.118	0.137	0.005	144	174
020	Estill Fork	ESTL-1	980818		8	7.7	335	5	6.6	144	1.0	204	1	<0.005	0.272	0.377	<0.005	150	170
020	Estill Fork	ESTL-1	981027	15	10.8	7.6	371	2	0.9	15	<0.1	217	4	<0.005	0.008	0.215	<0.005	159	166
020	Estill Fork	ESTL-1	990126	13	11.1	7.5	200	3	71.1	27	0.5	149	1	<0.005	0.273	0.273	<0.005	114	132
020	Estill Fork	ESTL-1	990427	15	9.6	7.8	295	9	66.7	110	<0.1	164	1	<0.005	0.163	0.287	<0.005	132	156
020	Estill Fork	ESTL-1	990525	20	8.5	7.5	316	2	5.4										
020	Estill Fork	ESTL-1	990629	19	8.8	7.3	303	10	70.7										
020	Estill Fork	ESTL-1	990824	26	6.3	7.7	358	3	1.2	32	2.0	204	4	<0.015	0.025	0.277	0.009	151	180
020	Estill Fork	ESTL-1	991027	16	6.8	7.7	424	2	0.3	8	1.6	244	3	<0.015	0.003	0.271	0.016	151	202
020	Estill Fork	ESTL-1	000119	11	10.1	8.1	213	1	13.3	15	2.3	155	1	<0.015	0.304	<0.15	<0.004	140	172

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 2. Physical / chemical data collected from Hurricane Creek, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
020	Hurricane Ck	HURR-1	970722	27	6.9	7.8	295	4		340	0.9	160	6	0.005	0.134	0.374	0.042	128	180
020	Hurricane Ck	HURR-1	970825	24	6.9	7.7	233	3	2.8	136	2.6	183	1	0.008	0.088	0.209	0.032	125	176
020	Hurricane Ck	HURR-1	970924	20	5.8	7.5	283	4		460	2.3	161	4	<0.05	0.079	0.258	0.040	120	152
020	Hurricane Ck	HURR-1	971021	13	7.6	7.7	305	4	2.9	176	0.6	176	3	<0.005	0.048	0.406	<0.005	127	150
020	Hurricane Ck	HURR-1	971118	8	10.9	7.9	135	2		42	0.7	139	1	<0.005	0.112	0.117	<0.005	104	156
020	Hurricane Ck	HURR-1	971216	8	11.3	7.5	228	3	30.1	12	0.1	124	2	<0.005	0.132	0.236	<0.005	97	110
020	Hurricane Ck	HURR-1	980205	9	10.6	7.7	192	17		112	0.9	115	13	<0.05	0.184	0.214	<0.05	78	98
020	Hurricane Ck	HURR-1	980225	14	10.6	7.6	167	4	89.2	2	1.3	120	2	<0.005	0.130	<0.05	<0.005	88	112
020	Hurricane Ck	HURR-1	980324	13	10.4	7.9	214	6	148.9	17	0.4	125	2	<0.005	0.105	0.128	<0.005	90	110
020	Hurricane Ck	HURR-1	980429	13	9.5	7.8	220	5	43.8	100	0.5	139	2	<0.005	0.106	0.033	0.028	97	124
020	Hurricane Ck	HURR-1	980526	22	8.3	7.8	280	4	8.9	248	0.9	166	1	<0.005	0.154	0.100	<0.05	120	156
020	Hurricane Ck	HURR-1	980622	22	8.5	7.9	258	5	20.5	144	1.6	159	1	<0.005	0.163	0.176	<0.005	114	138
020	Hurricane Ck	HURR-1	980818		7.2	7.6	288	4	4.8	90	0.9	172	2	<0.005	0.180	0.253	<0.005	126	150
020	Hurricane Ck	HURR-1	981027	13	8.5	7.5	317	4		60	0.2	202	10	<0.005	0.022	0.216	<0.005	139	164
020	Hurricane Ck	HURR-1	990126	14	10.4	7.3	144	7		32	0.6	113	3	<0.005	0.264	0.158	<0.005	77	84
020	Hurricane Ck	HURR-1	990427	15	9.6	7.7	232	19		580	<0.1	133	12	<0.005	0.154	0.329	<0.005	101	116
020	Hurricane Ck	HURR-1	990525	20	8.4	7.6	246	365	12.5										
020	Hurricane Ck	HURR-1	990629	17	8.7	7.1	228	28											
020	Hurricane Ck	HURR-1	990824	23	6.3	7.6	289	3		116	1.4	165	3	<0.015	0.086	0.229	0.012	125	146
020	Hurricane Ck	HURR-1	991027	14	6.6	7.6	337	3		8	1.8	179	3	<0.015	0.031	0.291	0.017	130	160
020	Hurricane Ck	HURR-1	000119							40	2.2	107	1	<0.015	0.157	<0.15	<0.004	90	118

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 3. Physical / chemical data collected monthly from Larkin Fork, July 1997 to October 1999.

Sub-Watershed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
040	Larkin Fork	LARK-1	970722	27	6.7	7.7	374	2		720	0.8	227	<1	0.03	0.112	0.281	0.036	167	214
040	Larkin Fork	LARK-1	970825	19	5.4	7.4	268	1		390	2.8	217	<1	<0.005	0.145	0.186	0.030	154	214
040	Larkin Fork	LARK-1	970924	21	5.6	7.6	306	4		460	2.5	171	2	<0.05	0.076	0.283	0.044	133	166
040	Larkin Fork	LARK-1	971021	15	8	7.7	356	3	2.1	**1840**	1.0	205	<1	<0.005	0.044	0.453	0.087	152	182
040	Larkin Fork	LARK-1	971118	7	11.4	7.5	205	1		25	0.9	215	<1	<0.005	0.424	0.123	<0.005	160	204
040	Larkin Fork	LARK-1	971216	9	12.3	7.6	347	2	24.0	15	0.2	191	1	<0.005	0.398	0.119	<0.005	148	174
040	Larkin Fork	LARK-1	980205	9	10.5	7.8	286	6		56	0.9	166	5	<0.05	0.574	0.213	<0.05	124	146
040	Larkin Fork	LARK-1	980225	17	9.3	7.7	248	2	65.8	30	1.4	170	1	<0.005	0.335	0.112	<0.005	118	164
040	Larkin Fork	LARK-1	980324	14	11.1	8	297	6	180.9	57	0.7	173	3	<0.005	0.650	0.186	<0.005	128	152
040	Larkin Fork	LARK-1	980428	15	8.9	7.8	306	3	31.2	128	0.7	160	2	<0.005	0.348	0.116	0.031	138	166
040	Larkin Fork	LARK-1	980526	23	7	7.6	333	4	2.8	132	1.1	191	2	<0.005	0.222	0.142	0.083	144	172
040	Larkin Fork	LARK-1	980622	24	7.1	7.7	327	10	10.7	300	1.1	197	6	<0.005	0.439	0.312	0.085	144	170
040	Larkin Fork	LARK-1	980818		6.7	7.7	349	8	8.8	96	0.9	212	6	<0.005	0.318	0.267	<0.005	154	186
040	Larkin Fork	LARK-1	981027	14	9.7	7.5	362	4	0.8	10	0.3	212	6	<0.005	0.030	0.228	<0.005	161	162
040	Larkin Fork	LARK-1	990126	13	10	7.5	212	4	108.6	164	0.4	160	3	<0.005	0.746	0.136	<0.005	121.5	144
040	Larkin Fork	LARK-1	990427	16	8.8	7.6	327	10	71.3	980	0.2	180	7	<0.005	0.390	**0.557**	<0.005	145	168
040	Larkin Fork	LARK-1	990525	25	7.4	7.4	320	3	8.7										
040	Larkin Fork	LARK-1	990629	20	8.3	7.2	327	11	100.9										
040	Larkin Fork	LARK-1	990824	25	6.2	7.6	333	4	1.1	68	2.1	188	<1	<0.015	0.050	0.289	0.019	148	172
040	Larkin Fork	LARK-1	991027	11	7.7	7.7	371	2	0.6	13	1.0	204	1	<0.015	0.034	0.327	0.018	146	182
040	Larkin Fork	LARK-1	000119	11	11.1	8.0	247	2	12.6	35	2.5	165	1	<0.015	0.579	0.065	<0.004	155	182

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 4. Physical / chemical data collected monthly from Dry Creek, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
050	Dry Ck	DRYJ-1	970722	26	6.8	7.8	268	6		**1020**	1.2	162	1	0.005	0.398	0.354	0.039	116	146
050	Dry Ck	DRYJ-1	970825	19	6.9	7.7	214	6	1.9	390	2.6	173	2	<0.005	0.357	0.163	0.035	124	184
050	Dry Ck	DRYJ-1	970924	21	6.5	7.6	274	13		510	3.8	155	7	<0.05	0.210	0.340	0.050	117	146
050	Dry Ck	DRYJ-1	971021	14	8.2	7.6	284	6	1.7	400	2.8	158	3	<0.005	0.221	0.505	<0.005	124	148
050	Dry Ck	DRYJ-1	971118	6	11.2	7.3	139	3		37	0.8	146	1	<0.005	0.318	0.130	<0.005	109	176
050	Dry Ck	DRYJ-1	971216	9	11.2	7.4	219	3	20.2	30	0.2	121	1	<0.005	0.302	0.075	<0.005	89	114
050	Dry Ck	DRYJ-1	980205	10	10.5	7.5	184	9		88	1.0	112	4	<0.05	0.288	0.075	<0.05	74	100
050	Dry Ck	DRYJ-1	980225	15	10.5	7.6	170	3	43.3	20	1.3	119	1	<0.005	0.271	0.075	<0.005	90	106
050	Dry Ck	DRYJ-1	980324	15	10.8	7.9	211	7	118.4	37	0.5	121	5	<0.005	0.476	0.199	<0.005	86	112
050	Dry Ck	DRYJ-1	980428	15	9.5	7.7	207	6	21.3	228	0.5	127	<1	<0.005	0.297	0.046	0.030	93	124
050	Dry Ck	DRYJ-1	980526	22	8	7.7	252	5	2.9	460	0.9	150	4	<0.005	0.372	<0.1	<0.05	109	136
050	Dry Ck	DRYJ-1	980622	24	7.9	7.8	249	5	5.6	280	0.9	151	3	<0.005	0.405	0.117	<0.005	110	132
050	Dry Ck	DRYJ-1	980818		7	7.9	285	6	3.9	360	0.8	168	3	<0.005	0.354	0.225	0.079	126	150
050	Dry Ck	DRYJ-1	981027	13	10.1	7.3	310	3		760	0.1	179	9	<0.005	0.235	0.227	<0.005	133	154
050	Dry Ck	DRYJ-1	990125	13	7.8	7.8	166	6	102.5	72	0.5	95	4	<0.005	0.480	0.306	<0.005	69	86
050	Dry Ck	DRYJ-1	990427	15	9.7	7.4	224	12	28.3	450	<0.1	119	8	<0.005	0.264	0.233	<0.005	100	114
050	Dry Ck	DRYJ-1	990525	18	7.7	8.1	231	5	6.2										
050	Dry Ck	DRYJ-1	990629	17	8.8	7.6	234	17	88.4										
050	Dry Ck	DRYJ-1	990824	25	5.7	7.7	280	3	1.2	104	1.8	157	<1	<0.015	0.291	0.251	0.015	124	140
050	Dry Ck	DRYJ-1	991027	13	8.4	7.8	355	2	0.6	33	1.5	187	3	<0.015	0.185	0.303	0.013	134	158
050	Dry Ck	DRYJ-1	000119	12	11.0	7.8	165	2	10.4	108	2.1	111	2	<0.015	0.602	<0.15	<0.004	106	132

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 5. Physical / chemical data collected monthly from Lick Fork, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
050	Lick Fork	LICK-1	970722	25	6.5	7.5	275	5		210	0.9	177	4	0.03	0.297	0.331	0.042	120	156
050	Lick Fork	LICK-1	970825	19	5.8	7.4	215	2		210	2.5	173	2	<0.005	0.303	0.192	0.032	115	196
050	Lick Fork	LICK-1	970924	20	6.5	7.5	230	25		400	4.2	135	16	<0.05	0.372	0.461	0.084	98	126
050	Lick Fork	LICK-1	971021	14	8.5	7.7	291	3	0.0	96	1.0	161	5	<0.005	0.174	0.404	<0.005	122	146
050	Lick Fork	LICK-1	971118	8	11.5	7.3	134	1		22	0.7	142	<1	<0.005	0.250	0.086	<0.005	105	184
050	Lick Fork	LICK-1	971216	9	11.9	7.4	234	2	10.1	17	0.1	129	1	<0.005	0.271	0.149	<0.005	96	124
050	Lick Fork	LICK-1	980205	9	10.5	7.7	201	4		54	1.1	109	<1	<0.05	0.253	<0.05	<0.05	83	106
050	Lick Fork	LICK-1	980225	16	11.3	7.7	183	2	31.8	10	1.4	122	<1	<0.005	0.225	0.056	0.044	99	112
050	Lick Fork	LICK-1	980324	14	10.6	7.8	224	5	79.7	25	0.4	130	1	<0.005	0.454	0.210	<0.005	95	118
050	Lick Fork	LICK-1	980428	14	9.5	7.8	223	3	16.9	200	0.6	134	<1	<0.005	0.252	0.041	0.025	99	132
050	Lick Fork	LICK-1	980526	22	8.4	7.6	264	3	1.1	600	1.0	157	1	<0.005	0.302	<0.1	<0.05	115	134
050	Lick Fork	LICK-1	980622	23	8.7	7.7	272	7	4.9	410	1.0	167	2	<0.005	0.393	0.185	<0.005	120	150
050	Lick Fork	LICK-1	980818		5.4	7.6	304	4		560	<0.01	181	2	<0.005	0.319	0.240	<0.005	134	150
050	Lick Fork	LICK-1	981027	14	9.9	7.4	299	4		152	<0.1	171	8	<0.005	0.131	0.158	<0.005	158	156
050	Lick Fork	LICK-1	990126	11	9.5	7.2	150	3	55.6	42	0.4	105	1	<0.005	0.468	0.175	<0.005	78	96
050	Lick Fork	LICK-1	990427	14	9.7	7.5	254	7		320	<0.1	134	2	<0.005	0.261	0.179	<0.005	114	126
050	Lick Fork	LICK-1	990525	23	8.5	7.4	253	2	4.1										
050	Lick Fork	LICK-1	990629	19	9.8	7.3	253	9	48.4										
050	Lick Fork	LICK-1	990824																
050	Lick Fork	LICK-1	991027																
050	Lick Fork	LICK-1	000119	12	10.9	8.0	167	2	6.0	27	2.6	112	1	<0.015	0.492	<0.15	<0.004	106	140

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 6. Physical / chemical data collected monthly from Guess Creek, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
060	Guess Ck	GUES-1	970723	21	6.5	7.3	210	10	4.3	370	0.9	122	1	0.005	0.211	0.233	0.038	88	130
060	Guess Ck	GUES-1	970825	17	6	7.3	177	6		260	2.4	140	1	<0.005	0.256	0.104	0.032	96	136
060	Guess Ck	GUES-1	970924	20	4.4	7.4	244	6		**1000**	1.9	138	3	<0.05	0.143	0.223	0.065	103	128
060	Guess Ck	GUES-1	971021	13	5.9	7.3	242	5	1.4	320	0.6	133	1	**0.090**	0.209	0.452	<0.005	102	124
060	Guess Ck	GUES-1	971118	9	9.9	7.1	69	2		92	0.7	72	<1	<0.005	0.227	0.094	<0.005	50	88
060	Guess Ck	GUES-1	971216	10	10.6	7.3	114	3	27.6	12	<0.1	67	2	<0.005	0.311	<0.05	<0.005	40	56
060	Guess Ck	GUES-1	980205	9	10.8	7.4	96	6		49	0.9	60	4	<0.05	0.303	0.062	<0.05	33	52
060	Guess Ck	GUES-1	980225	15	11	7.2	87	4	78.2	7	1.7	64	<1	<0.005	0.291	<0.05	<0.005	41	52
060	Guess Ck	GUES-1	980324	12	10.9	7.8	119	6	104.0	10	0.1	70	1	<0.005	0.494	0.207	<0.005	41	72
060	Guess Ck	GUES-1	980428	14	9.5	7.4	121	4	28.8	32	0.7	67	3	<0.005	0.232	0.036	0.029	52	58
060	Guess Ck	GUES-1	980526	16	8.2	7.4	174	6	9.0	296	1.2	110	1	<0.005	0.232	<0.1	<0.05	75	100
060	Guess Ck	GUES-1	980622	17	12.9	7.8	156	63	10.6	800	1.3	107	11	<0.005	0.446	0.354	0.112	68	90
060	Guess Ck	GUES-1	980818		7.2	7.9	205	9	4.1	340	1.0	130	2	<0.005	0.324	0.144	<0.005	90	120
060	Guess Ck	GUES-1	981027	13	6.1	7.3	261	6		116	0.1	145	3	<0.005	0.141	0.142	<0.005	117	130
060	Guess Ck	GUES-1	990125	12	10.8	7.9	86	5	125.2	30	0.5	55	3	<0.005	0.510	0.159	<0.005	114	132
060	Guess Ck	GUES-1	990427	14	9.5	6.8	124	4	29.8	230	<0.1	62	2	<0.005	0.196	<0.15	<0.005	51	72
060	Guess Ck	GUES-1	990524	18	8.4	7.3	155	3	9.1										
060	Guess Ck	GUES-1	990629	14	9.4	7.7	139	14											
060	Guess Ck	DUP001	990824	23	3.7	7.2	232	4		**1060**	1.9	129	4	<0.015	0.163	0.211	0.014	95	114
060	Guess Ck	GUES-1	990824	23	3.7	7.3	237	4	1.1	980	2.1	128	16	<0.015	0.158	0.258	0.01	101	114
060	Guess Ck	GUES-1	991027						0.0										
060	Guess Ck	GUES-1	000119	13	9.8	7.1	87	2	19.8	25	2.3	50	<1	<0.015	0.619	<0.15	<0.004	44	66

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 7. Physical / chemical data collected monthly from Cole Springs Branch, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
070	Cole Spr. Branch	CSPR-1	970723	24	7.1	7.5	350	16	2.1	**>1200**	0.9	207	7	**0.054**	**2.814**	0.179	0.053	144	170
070	Cole Spr. Branch	CSPR-1	970825	19	5.9	7.6	275	34	1.0	740	2.1	220	36	<0.005	**2.581**	0.046	0.075	144	180
070	Cole Spr. Branch	CSPR-1	970924	20	5.9	7.2	354	16	1.4	**1620**	3.6	189	15	**0.066**	**2.100**	0.376	0.107	135	174
070	Cole Spr. Branch	CSPR-1	971021	15	7.7	7.4	345	6	1.5	940	0.8	196	4	**0.072**	**2.231**	0.499	**0.156**	145	172
070	Cole Spr. Branch	CSPR-1	971118	10	8.7	6.9	185	14	1.5	380	1.1	195	32	<0.005	**3.270**	<0.05	<0.005	120	160
070	Cole Spr. Branch	CSPR-1	971216	13	9.4	7.4	364	11	6.2	76	0.3	185	13	<0.005	**2.039**	<0.05	<0.005	125	160
070	Cole Spr. Branch	CSPR-1	980205	10	9.7	7.6	252	17		430	1.6	144	14	<0.05	1.104	0.377	0.076	95	138
070	Cole Spr. Branch	CSPR-1	980225	13	11.1	7.1	234	6	18.4	100	6.2	164	6	<0.005	**1.554**	<0.05	0.056	121	156
070	Cole Spr. Branch	CSPR-1	980324	14	9.1	7.3	241	41	51.1	**>1200**	4.6	166	24	<0.005	1.200	**1.334**	**0.192**	92	124
070	Cole Spr. Branch	CSPR-1	980428	15	8.6	7.5	303	7	13.7	200	0.7	172	3	<0.005	**2.349**	<0.005	0.034	130	164
070	Cole Spr. Branch	CSPR-1	980526	18	8.3	7.4	330	9	4.5	300	0.6	196	7	<0.005	<0.005	<0.1	0.055	136	166
070	Cole Spr. Branch	CSPR-1	980622	22	7.4	7.7	345	6	0.0	**1200**	1.3	200	13	<0.005	**2.164**	0.125	<0.005	143	186
070	Cole Spr. Branch	CSPR-1	980818		5.9	7.7	360	18		**1300**	1.1	221	12	<0.005	**2.537**	0.127	0.084	154	182
070	Cole Spr. Branch	CSPR-1	981027	14	7.2	6.9	371	13		310	0.5	215	31	<0.005	**1.602**	0.386	0.094	159	186
070	Cole Spr. Branch	CSPR-1	990125	14	9.5	7.3	247	12	54.9	252	1.0	147	13	<0.005	**2.193**	0.295	<0.005	93.5	116
070	Cole Spr. Branch	CSPR-1	990427	18	2.5	6.9	514	447	12.6	**TNTC**	>156	452	204	**11.834**	0.863	**39.4**	**4.584**	158	207
070	Cole Spr. Branch	CSPR-1	990524	22	7.5	8	322	9	4.3										
070	Cole Spr. Branch	CSPR-1	990629	19	8	8	290	13	28.1										
070	Cole Spr. Branch	CSPR-1	990824	22	5.3	7.4	351	24		720	2.8	204	79	<0.015	**2.707**	0.416	0.031	148	174
070	Cole Spr. Branch	CSPR-1	991027						0.0										
070	Cole Spr. Branch	CSPR-1	000119	12.0	8.0	7.6	247.0	6.1	4.1	148.0	2.8	179	6	<0.015	**1.9**	0.2	0.0	150	184

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 8. Physical / chemical data collected monthly from Clear Creek, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
080	Clear Ck	CLER-1	000119	12	11.6	8.4	185	4	6.5	70	2.7	138	1	<0.015	0.44	<0.150	<0.004	125	152
080	Clear Ck	CLER-1	970722	27	8.9	8.1	284	3		360	1.0	168	<1	<0.005	0.359	0.374	0.039	125	158
080	Clear Ck	CLER-1	970825	19	6.5	7.8	221	12	1.0	340	2.5	182	35	<0.005	0.255	0.260	0.049	131	180
080	Clear Ck	CLER-1	970924	20	6.6	7.2	240	52	1.3	**4200**	3.0	159	36	<0.05	0.317	0.365	0.089	108	134
080	Clear Ck	CLER-1	971021	15	10	8	289	5	0.5	192	1.1	160	1	<0.005	0.138	**0.798**	<0.005	123	150
080	Clear Ck	CLER-1	971118	5	11.3	7.2	152	4		35	1.1	155	<1	<0.005	0.256	0.181	<0.005	116	166
080	Clear Ck	CLER-1	971216	9	12.3	7.5	245	3	7.3	57	0.1	133	2	<0.005	0.256	0.050	<0.005	100	124
080	Clear Ck	CLER-1	980205	10	10.3	7.7	205	8		77	1.0	119	<1	<0.05	0.283	<0.05	<0.05	80	118
080	Clear Ck	CLER-1	980225	16	10.7	7.7	180	4	25.8	30	1.6	128	2	<0.005	0.224	0.089	0.051	99	120
080	Clear Ck	CLER-1	980324	13	10.7	7.8	232	10	105.2	72	0.5	137	3	0.005	0.452	0.185	<0.005	96	128
080	Clear Ck	CLER-1	980428	14	10.3	7.7	223	4	17.7	124	0.8	94	<1	<0.005	0.310	0.086	0.025	99	122
080	Clear Ck	CLER-1	980526	22	9.5	7.9	262	4	3.2	720	0.9	153	3	<0.005	0.177	0.156	<0.05	120	140
080	Clear Ck	CLER-1	980622	26	8.9	7.9	282	4	1.3	82	1.1	160	1	<0.005	0.279	0.153	<0.005	122	150
080	Clear Ck	CLER-1	980818		8.9	8.1	302	5	1.0	80	1.1	188	5	<0.005	0.249	0.269	0.106	134	164
080	Clear Ck	CLER-1	981027	17	10.3	7.6	308	2	0.3	80	<0.1	182	4	<0.005	0.096	0.169	<0.005	132	150
080	Clear Ck	CLER-1	990125	14	10.4	7.6	175	7	82.3	55	0.4	102	10	<0.005	0.508	0.209	<0.005	73	94
080	Clear Ck	CLER-1	990427	16	10.7	7.9	238	8	17.1	720	0.1	125	5	<0.005	0.271	0.352	<0.005	104	118
080	Clear Ck	CLER-1	990524	23	9.4	7.9	241	2	5.3										
080	Clear Ck	CLER-1	990629	16	9.5	7.8	265	11	15.2										
080	Clear Ck	CLER-1	990824	28	8.5	7.9	298	2	0.5	70	2.5	168	13	<0.015	0.267	0.24	0.027	130	146
080	Clear Ck	CLER-1	991027	15	10	8	336	2	0.2	56	1.7	180	3	<0.015	0.02	0.256	0.013	132	154
080	Clear Ck	CLER-1	000119	12	11.6	8.4	185	4	6.5	70	2.7	138	1	<0.015	0.44	<0.15	<0.004	125	152

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 9. Physical / chemical data collected monthly from Little Paint Creek, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
090	Little Paint Ck	LPNT-1	970723	27	7	7.6	336	5	2.5	108	1.0	200	2	0.033	0.708	0.423	0.055	145	182
090	Little Paint Ck	LPNT-1	970825	23	8.1	7.9	217	4		172	2.7	172	1	<0.005	0.269	0.25	0.034	121	176
090	Little Paint Ck	LPNT-1	970924	21	7.4	7.7	283	23	5.2	700	3.1	161	29	<0.05	0.138	0.462	0.076	119	144
090	Little Paint Ck	LPNT-1	971021	13	9.3	7.6	309	3	4.5	228	0.5	172	1	<0.005	0.351	**0.594**	**0.176**	132	150
090	Little Paint Ck	LPNT-1	971118	8	12.9	7.3	145	7		40	1.1	149	2	<0.005	0.549	0.201	**0.166**	105	138
090	Little Paint Ck	LPNT-1	971216	10	12.3	7.3	291	5	23.8	32	0.1	164	3	<0.005	0.550	0.271	<0.005	120	146
090	Little Paint Ck	LPNT-1	980205	9	10.2	7.6	230	30		370	1.1	141	23	<0.05	0.484	<0.05	0.074	94	118
090	Little Paint Ck	LPNT-1	980225	17	10.3	7.6	238	10	79.3	20	1.5	163	7	<0.005	0.445	<0.05	0.056	120	140
090	Little Paint Ck	LPNT-1	980324	15	10.1	7.8	291	27		116	0.8	180	26	<0.005	0.400	0.325	0.07	128	154
090	Little Paint Ck	LPNT-1	980428	14	9.7	7.9	266	5	29.3	25	0.7	156	1	<0.005	0.452	0.090	0.027	116	148
090	Little Paint Ck	LPNT-1	980527	22	6.5	7.5	296	9	8.2	240	1.1	175	5	<0.005	0.415	0.176	<0.05	125	158
090	Little Paint Ck	LPNT-1	980623	27	6.9	7.6	306	6	2.3	172	1.2	186	3	<0.005	0.361	0.306	<0.005	131	158
090	Little Paint Ck	LPNT-1	980818		8.4	7.7	347	11	3.9	156	1.4	214	7	<0.005	0.581	**0.578**	0.085	147	182
090	Little Paint Ck	LPNT-1	981027	17	10.4	7.8	347	3	0.2	212	0.6	197	5	<0.005	0.017	0.306	<0.005	149	162
090	Little Paint Ck	LPNT-1	990126	16	9.1	7.1	183	30		132	0.8	153	32	<0.005	1.241	0.522	0.100	84	118
090	Little Paint Ck	LPNT-1	990427	18	10	7.8	259	8	29.6	480	0.2	138	7	<0.005	0.449	0.220	<0.005	109	138
090	Little Paint Ck	LPNT-1	990526	19	6.9	7.3	256	6	9.7										
090	Little Paint Ck	LPNT-1	990630	19	8.3	7.3	242	38											
090	Little Paint Ck	LPNT-1	990825	25	6.2	7.7	288	4	2.1	52	1.6	165	4	<0.015	0.196	0.353	0.011	121	140
090	Little Paint Ck	LPNT-1	991028	11	9.5	7.6	370	4	0.6	112	2.1	197	24	<0.015	0.191	0.325	0.02	147	176
090	Little Paint Ck	LPNT-1	000119	10	9.6	8.1	184	7.3	27.7	60	2.2	136	5	<0.015	1.180	0.080	0.015	113	136

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 10. Physical / chemical data collected monthly from Little Paint Rock Creek, July 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
100	Little Paint Rock Ck	LPRK-1	970722	26	7.1	7.7	241	69		**>1200**	1.7	155	64	0.03	0.287	**0.834**	0.091	105	134
100	Little Paint Rock Ck	LPRK-1	970825	20	6.6	7.7	214	37	0.4	**>1200**	3.4	182	28	<0.005	0.261	0.493	0.073	125	168
100	Little Paint Rock Ck	LPRK-1	970924	23	7.2	6.9	93	1000	104.7	700	7.3	19	1950	0.102	0.340	**4.795**	**2.285**	31	52
100	Little Paint Rock Ck	LPRK-1	971021	13	8.2	7.5	249	9	2.7	560	0.9	141	2	<0.005	0.221	0.454	0.065	107	124
100	Little Paint Rock Ck	LPRK-1	971118	9	11	7.5	117	4	3.8	50	0.9	126	<1	<0.005	0.346	<0.05	**0.156**	86	110
100	Little Paint Rock Ck	LPRK-1	971216	9	11.1	7.2	221	5	6.5	88	0.3	123	3	<0.005	0.396	0.173	<0.005	88	108
100	Little Paint Rock Ck	LPRK-1	980205	9	10.5	7.5	171	20		208	1.1	109	15	<0.05	0.435	0.208	<0.05	68	114
100	Little Paint Rock Ck	LPRK-1	980226	11	9.9	7.6	148	8	14.9	57	1.7	118	12	<0.005	0.433	0.091	0.053	83	104
100	Little Paint Rock Ck	LPRK-1	980324	15	9.5	7.7	208	22	30.9	340	0.5	131	14	<0.005	0.295	0.378	0.039	88	108
100	Little Paint Rock Ck	LPRK-1	980428	15	9.3	7.7	223	12	6.7	740	0.9	129	7	<0.005	0.424	0.144	0.036	99	110
100	Little Paint Rock Ck	LPRK-1	980527	21	7	7.5	244	92	2.9	**>6000**	2.2	165	46	<0.005	0.467	**0.620**	0.133	102	116
100	Little Paint Rock Ck	LPRK-1	980623	26	4.9	7.4	290	315	0.5	**>1200**	>6.9	194	306	**0.093**	0.498	**3.038**	**0.325**	126	148
100	Little Paint Rock Ck	LPRK-1	980819		6.3	7.6	282	17	1.1	400	1.1	175	12	<0.005	0.446	0.379	0.117	123	152
100	Little Paint Rock Ck	DUP001	990127	13	9.5	7.2	128	11		192	0.7	114	10	<0.005	0.898	0.281	**0.178**	61	80
100	Little Paint Rock Ck	LPRK-1	990127	13	9.6	7	125	12	20.4	152	0.7	117	11	<0.005	0.900	0.381	<0.005	61	80
100	Little Paint Rock Ck	LPRK-1	990427	18	8.3	7.5	215	37	10.4	**TNTC**	0.7	125	26	<0.005	0.369	**0.588**	0.102	90	104
100	Little Paint Rock Ck	LPRK-1	990526	19	7.3	7	216	12	3.8										
100	Little Paint Rock Ck	DUP001	990630	22	8.1	7.4	191	14											
100	Little Paint Rock Ck	LPRK-1	990630	22	8.1	7.4	178	15	36.6										
100	Little Paint Rock Ck	LPRK-1	990825																
100	Little Paint Rock Ck	LPRK-1	991028																
100	Little Paint Rock Ck	LPRK-1	000119	10	9.9	7.5	128	7	5.9	112	2.1	88	4	<0.015	0.827	0.1	0.013	75	102

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix A, Table 11. Physical / chemical data collected monthly from Paint Rock River , September 1997 to October 1999.

Sub-Water-shed	Stream	Station	Date *yymmdd*	Water Temp. *C*	D.O. *mg/l*	pH *s.u.*	Cond. *umhos@ 25C*	Turb. *NTU*	Flow *cfs*	Fecal Coliform *col/ 100ml*	BOD-5 *mg/L*	TDS *mg/L*	TSS *mg/L*	NH3 *mg/L*	NO3 + NO2 *mg/L*	TKN *mg/L*	T-PO4 *mg/l*	ALK *mg/l*	HARD *mg/l*
100	Paint Rock River	PTRK-1	970924	22	6.8	7.5	150	568		**2620**	6.9	112	273	**0.073**	0.717	1.309	0.442	55	76
100	Paint Rock River	PTRK-1	971021	13	7.8	7.7	318	12		184	0.7	180	12	**0.090**	0.460	0.644	<0.005	134	156
100	Paint Rock River	PTRK-1	971118	7	11	7.5	166	5		55	0.8	174	1	<0.005	0.474	0.179	<0.005	121	158
100	Paint Rock River	PTRK-1	971216	8	11	7.4	273	6		42	0.1	155	4	<0.005	0.410	0.233	<0.005	111	140
100	Paint Rock River	PTRK-1	980205	7	10.5	7.6	179	58		**1040**	1.5	141	22	<0.05	0.191	0.625	0.108	73	106
100	Paint Rock River	PTRK-1	980226	13	9.7	7.8	181	11		32	1.5	138	11	<0.005	0.434	0.116	0.059	101	120
100	Paint Rock River	PTRK-1	980324	13	9.8	7.6	219	28		580	0.7	139	18	<0.005	0.375	0.338	0.075	91	114
100	Paint Rock River	DUP001	980429	15	9.4	7.7	218	11		620	0.9	132	7	<0.005	0.418	0.121	0.037	97	110
100	Paint Rock River	PTRK-1	980429	16	8.1	7.5	234	13		204	0.9	135	10	0.005	0.442	0.172	0.048	103	122
100	Paint Rock River	PTRK-1	980527	24	6.2	7.4	281	23		**1528**	1.7	170	18	<0.005	0.618	0.285	0.079	115	152
100	Paint Rock River	PTRK-1	980623	27	6.1	7.5	282	15		104	1.0	161	15	<0.005	0.321	0.244	<0.005	121	144
100	Paint Rock River	PTRK-1	980819		4.5	7.5	270	15		76	1.4	170	12	<0.005	0.458	0.448	0.092	113	162
100	Paint Rock River	PTRK-1	981027	13	6.7	7.3	316	12		80	0.3	182	13	**0.078**	0.329	0.473	0.086	134	154
100	Paint Rock River	PTRK-1	990127	13	7.9	6.9	137	26		180	1.0	128	11	<0.005	0.468	0.617	0.106	70	82
100	Paint Rock River	PTRK-1	990427	19	8.1	7.6	255	9		280	<0.1	131	10	<0.005	0.390	0.253	<0.005	107	120
100	Paint Rock River	PTRK-1	990526	24	6.6	7.5	261	10											
100	Paint Rock River	PTRK-1	990630	21	6.9	7.4	238	53											
100	Paint Rock River	PTRK-1	990825		6.7	7.8	299	12		116	3.0	178	17	<0.015	0.085	0.501	0.048	132	146
100	Paint Rock River	PTRK-1	991028	15	7.7	7.8	323	11		13	1.9	165	16	<0.015	0.125	**0.517**	0.041	126	152
100	Paint Rock River	PTRK-1	000120	11	9.2	7.9	176	9.8		100	1.8	137	10	<0.015	0.753	0.092	0.026	110	140

BOD-5= 5-day biochemical oxygen demand, TDS=total dissolved solids, TSS=total suspended solids, NH3=ammonia, NO2+ NO3=nitrite/ nitrate, TKN=total Kjedahl nitrogen, TP=total phosphate, ALK= alkalinity, HARD = hardness

Appendix B. Pesticide data collected in the water column from July 1997 to June 1999 as part of the Paint Rock Nonpoint Source Monitoring Project. Pesticides analyzed but not detected are listed below[a].

Sub-Watershed	Stream	Station	Date	Simazine	Atrazine	Metolachlor	Di (2-Ethyl-hexyl) adipate	Pendi-methalin	Bis (2-Ethylhexyl) phthalate	Bis (2-Ethylhexyl) adipate	Di (2-Ethylhexyl) phthalate
			yymmdd	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*
020	Estill Fork	ESTL-1	971021	*	*	*	*	*	*	*	*
020	Estill Fork	ESTL-1	980526	*	*	*	0.283	*	*	*	0.235
020	Estill Fork	ESTL-1	980622	*	*	*	*	*	*	*	0.139
020	Estill Fork	ESTL-1	981027	*	*	*	*	*	*	*	*
020	Estill Fork	ESTL-1	990525	*	*	*	*	*	*	*	*
020	Estill Fork	ESTL-1	990629	*	*	*	*	*	*	*	*
020	Estill Fork	ESTL-1	991027	*	*	*	*	*	0.450	0.170	*
020	Hurricane	HURR-1	971021	*	*	*	*	*	*	*	*
020	Hurricane	HURR-1	980526	*	*	*	*	*	*	*	0.436
020	Hurricane	HURR-1	980622	*	*	*	*	*	*	*	0.103
020	Hurricane	HURR-1	981027	*	*	*	*	*	*	*	*
020	Hurricane	HURR-1	990525	*	*	*	*	*	*	*	*
020	Hurricane	HURR-1	990629	*	*	*	*	*	*	*	*
020	Hurricane	HURR-1	990629	*	*	*	*	*	0.370	0.150	*
040	Larkin Fork	LARK-1	971021	*	*	*	*	*	*	*	*
040	Larkin Fork	LARK-1	980526	*	*	*	*	*	*	*	0.572
040	Larkin Fork	LARK-1	980622	*	*	*	*	*	*	*	0.364
040	Larkin Fork	LARK-1	981027	*	*	*	*	*	*	*	*
040	Larkin Fork	LARK-1	990525	*	*	*	*	*	*	*	*
040	Larkin Fork	LARK-1	990629	*	*	*	*	*	*	*	*
040	Larkin Fork	LARK-1	991027	*	*	*	*	*	0.33	*	*
050	Lick Fork	LICK-1	971021	*	*	*	*	*	*	*	*
050	Lick Fork	LICK-1	980526	*	*	*	*	*	*	*	*
050	Lick Fork	LICK-1	980622	*	0.125	0.109	*	0.103	*	*	0.210
050	Lick Fork	LICK-1	981027	*	*	*	*	*	*	*	*
050	Lick Fork	LICK-1	990525	*	*	*	*	*	*	*	*
050	Lick Fork	LICK-1	990629	*	*	*	*	*	*	*	*
050	Dry	DRYJ-1	971021	*	*	*	*	*	*	*	*
050	Dry	DRYJ-1	980526	*	*	0.112	*	*	*	*	0.269
050	Dry	DRYJ-1	980622	*	0.118	*	*	*	*	*	0.159
050	Dry	DRYJ-1	981027	*	*	*	*	*	*	*	*
050	Dry	DRYJ-1	990525	*	*	*	*	*	*	*	*
050	Dry	DRYJ-1	990629	*	*	*	*	*	*	*	*
050	Dry	DRYJ-1	991027	*	*	*	*	*	0.210	0.220	*

a. Synthetic Organic Compounds (EPA 525.2): Benzo(a) pyrene, Butachlor, Chlorimuron ethyl, cis-Cypermethrin, Dieldrin, Endrin, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Methoxychlor, metolachlor, Metribuzin, Norflurazon, Pendimethlin, Propachlor, Simazine, Trifluralin; Carbamates by HPLC (EPA 531.1): 3-Hydroxycarbofuran, aldicarb, Aldicarb Sulfone, Aldicarb Sulfoxide, Carbaryl (Sevin), Carbofuran, Methomyl, Oxamyl, Glyphosphate; Phosphorus Pestices in Liquid (SW8141): Azinphos methyl, Diazinon, Ethion, Malathion, Mevinphos, Parathon ethyl, Parathion methyl; Herbicides in Liquid (SW 8151): 2,4,5-T, 2,4-D, Acifluoren-sodium, Bentazon, Silvex

*Below minimum detection limit of 0.1 ug/L

Appendix B. Pesticide data collected in the water column from July 1997 to June 1999 as part of the Paint Rock Nonpoint Source Monitoring Project. Pesticides analyzed but not detected are listed below[a].

Sub-Watershed	Stream	Station	Date	Simazine	Atrazine	Metolachlor	Di (2-Ethyl-hexyl) adipate	Pendi-methalin	Bis (2-Ethylhexyl) phthalate	Bis (2-Ethylhexyl) adipate	Di (2-Ethylhexyl) phthalate
			yymmdd	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*	*ug/l*
060	Guess	GUES-1	971021	*	*	*	*	*	*	*	*
060	Guess	GUES-1	980526	*	*	*	*	*	*	*	1.060
060	Guess	GUES-1	980622	*	*	*	*	*	*	*	0.150
060	Guess	GUES-1	981027	*	*	*	*	*	*	*	*
060	Guess	GUES-1	990524	*	*	*	*	*	*	*	*
060	Guess	GUES-1	990629	*	*	*	*	*	*	*	*
070	Cole Spring	CSPR-1	971021	*	*	*	*	*	*	*	*
070	Cole Spring	CSPR-1	980526	*	*	*	*	*	*	*	0.159
070	Cole Spring	CSPR-1	980622	*	0.168	*	*	*	*	*	0.433
070	Cole Spring	CSPR-1	981027	*	*	*	*	*	*	*	*
070	Cole Spring	CSPR-1	990524	*	0.814	*	*	*	*	*	*
070	Cole Spring	CSPR-1	990629	*	*	*	*	*	*	*	*
080	Clear	CLER-1	971021	*	*	*	*	*	*	*	*
080	Clear	CLER-1	980526	*	*	*	0.255	*	*	*	0.459
080	Clear	CLER-1	980622	*	*	*	*	*	*	*	0.281
080	Clear	CLER-1	981027	*	*	*	*	*	*	*	*
080	Clear	CLER-1	990524	*	*	*	*	*	*	*	*
080	Clear	CLER-1	990629	*	*	*	*	*	*	*	*
080	Clear	CLER-1	991027	*	*	*	*	*	0.35	0.15	*
090	L. Paint	LPNT-1	971021	*	*	*	*	*	*	*	*
090	L. Paint	LPNT-1	980527	*	*	*	*	*	*	*	0.260
090	L. Paint	LPNT-1	980623	*	*	*	*	*	*	*	0.213
090	L. Paint	LPNT-1	981027	*	*	*	*	*	*	*	*
090	L. Paint	LPNT-1	990526	*	*	*	*	*	*	*	*
090	L. Paint	LPNT-1	990630	*	*	*	*	*	*	*	*
090	L. Paint	LPNT-1	991027	*	*	*	*	*	0.220	*	*
100	L. Paint Rock	LPRK-1	971021	*	*	*	*	*	*	*	*
100	L. Paint Rock	LPRK-1	980527	*	*	*	1.97	*	*	*	0.417
100	L. Paint Rock	LPRK-1	980623	*	*	*	*	*	*	*	0.287
100	L. Paint Rock	LPRK-1	990526	*	*	*	*	*	*	*	*
100	L. Paint Rock	LPRK-1	990630	*	*	*	*	*	*	*	*
100	Paint Rock	PTRK-1	971021	*	*	*	*	*	*	*	*
100	Paint Rock	PTRK-1	980527	*	3.170	*	*	0.116	*	*	0.272
100	Paint Rock	PTRK-1	980623	*	*	*	*	*	*	*	0.358
100	Paint Rock	PTRK-1	981027	*	*	*	*	*	*	*	*
100	Paint Rock	PTRK-1	990526	*	1.01	*	*	*	*	*	*
100	Paint Rock	PTRK-1	990630	*	*	*	*	*	*	*	*
100	Paint Rock	PTRK-1	991027	*	*	*	*	*	0.830	0.180	*

a. Synthetic Organic Compounds (EPA 525.2): Benzo(a) pyrene, Butachlor, Chlorimuron ethyl, cis-Cypermethrin, Dieldrin, Endrin, Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Methoxychlor, metolachlor, Metribuzin, Norflurazon, Pendimethlin, Propachlor, Simazine, Trifluralin; Carbamates by HPLC (EPA 531.1): 3-Hydroxycarbofuran, aldicarb, Aldicarb Sulfone, Aldicarb Sulfoxide, Carbaryl (Sevin), Carbofuran, Methomyl, Oxamyl, Glyphosphate; Phosphorus Pestices in Liquid (SW8141): Azinphos methyl, Diazinon, Ethion, Malathion, Mevinphos, Parathon ethyl, Parathion methyl; Herbicides in Liquid (SW 8151): 2,4,5-T, 2,4-D, Acifluoren-sodium, Bentazon, Silvex

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