Turkey Creek Watershed Demonstration Project

OCC Task #86
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Final Report

Submitted by:

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Introduction:

Turkey Creek is located in the central great plains ecoregion in North Central Oklahoma. Streams throughout this wheat and cattle producing area are nearly universally threatened by nutrients, suspended solids, and siltation problems. Streams in this area are frequently plowed to the stream bank and the smallest watercourses are plowed over. Turkey Creek is a tributary of the Cimarron River.

This is a is new region for the 319 program and embraces a different sort of farmer than those of Eastern Oklahoma where much of the State's previous 319(h) projects have focused. Programs to date in this region have been traditional production oriented projects directed by the Natural Resources Conservation Service (NRCS). Projects have emphasized erosion control and gully treatment directed at increased agricultural production. With this in mind, the process to address NPS pollutants in this watershed must be carefully designed to build local support.

This project will follow a phased approach with the expectation that additional funds will be available through future 319(h) grants. However, given the uncertainty of the availability of future funding NPS pollution control strategies for the Turkey Creek watershed will be designed so that it can be continued at the local level with direction by a local sponsor.

Activities to address Nonpoint Source Pollution in the region need to be based on sound and current data identifying the problems in the stream, the *Causes* (pollutants) and then the categorical and geographical *Sources* causing problems in the stream. This project will focus on Turkey Creek as representative of the streams in this region. The objectives of Phase I will be to look at the evaluated data and determine the extent of the problem(s) originally identified in the 1988 Nonpoint Assessment Report. This will be accomplished by conducting monthly water quality monitoring, habitat assessments along with biological collections. This is crucial since the data is older than 10 years. We also want to insure that there are not additional problems that have gone un-noticed.

Project Area Description:

Turkey Creek watershed is located in the wheat and cattle producing area of Central Oklahoma, in Alfalfa, Major, Garfield, and Kingfisher counties (Figures 1 and 2). It joins the Cimarron River near the town of Dover. Turkey Creek was selected as a priority water body for the Oklahoma 319 program because its pollution problems are typical of agricultural areas of Central and North Central Oklahoma.

The 1988 NPS Assessment Report identified 81 miles (segment 620919) as threatened by agricultural sources. The report notes elevated suspended solids and phosphorus under high flow conditions; nutrients, suspended solids, and siltation as problems caused largely by excessive erosion; high flow data show elevated levels of suspended solids and total phosphorus; associated EPA Cause Code would be nutrients (9), siltation (11), and suspended solids (21); most pollutants likely attached to soil particles; excessive erosion from cropland indicated; and high flow collections show elevated levels of suspended solids and total phosphorus. This could

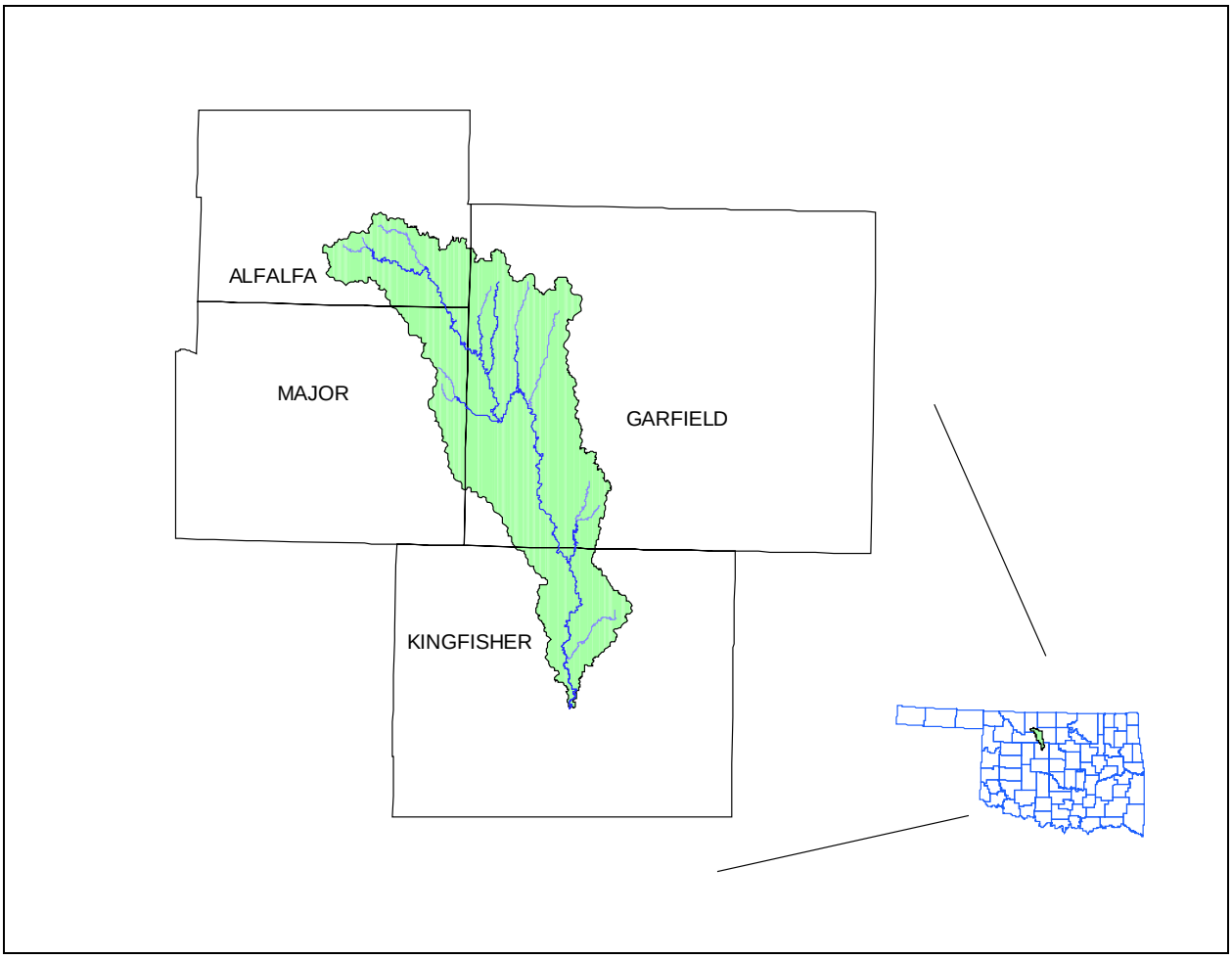

Figure 1. Turkey Creek Watershed Location.

disturb bottom habitat and encourage excess algal growth, which could lead to undesirable fluctuations in dissolved oxygen. These factors could impact the fishery resource. The assessment is derived from evaluated information with the water resources currently described as fully supporting but threatened. The beneficial uses potentially affected include warm water fishery (3) and recreation (40).

Project Objectives:

The Turkey Creek Demonstration project was intended to be divided into three phases carried out over several grant cycles. The program was designed so that each phase builds on the previous one. This project was intended to lay the ground work and build local support for a continuing process to control nonpoint source impacts to Turkey Creek. This project included monitoring, technical assistance, educational assistance and a demonstration of management practices directed at the improvement of the water resources and stream health of Turkey Creek. Specifically, the objectives of this project were in Phase I to:

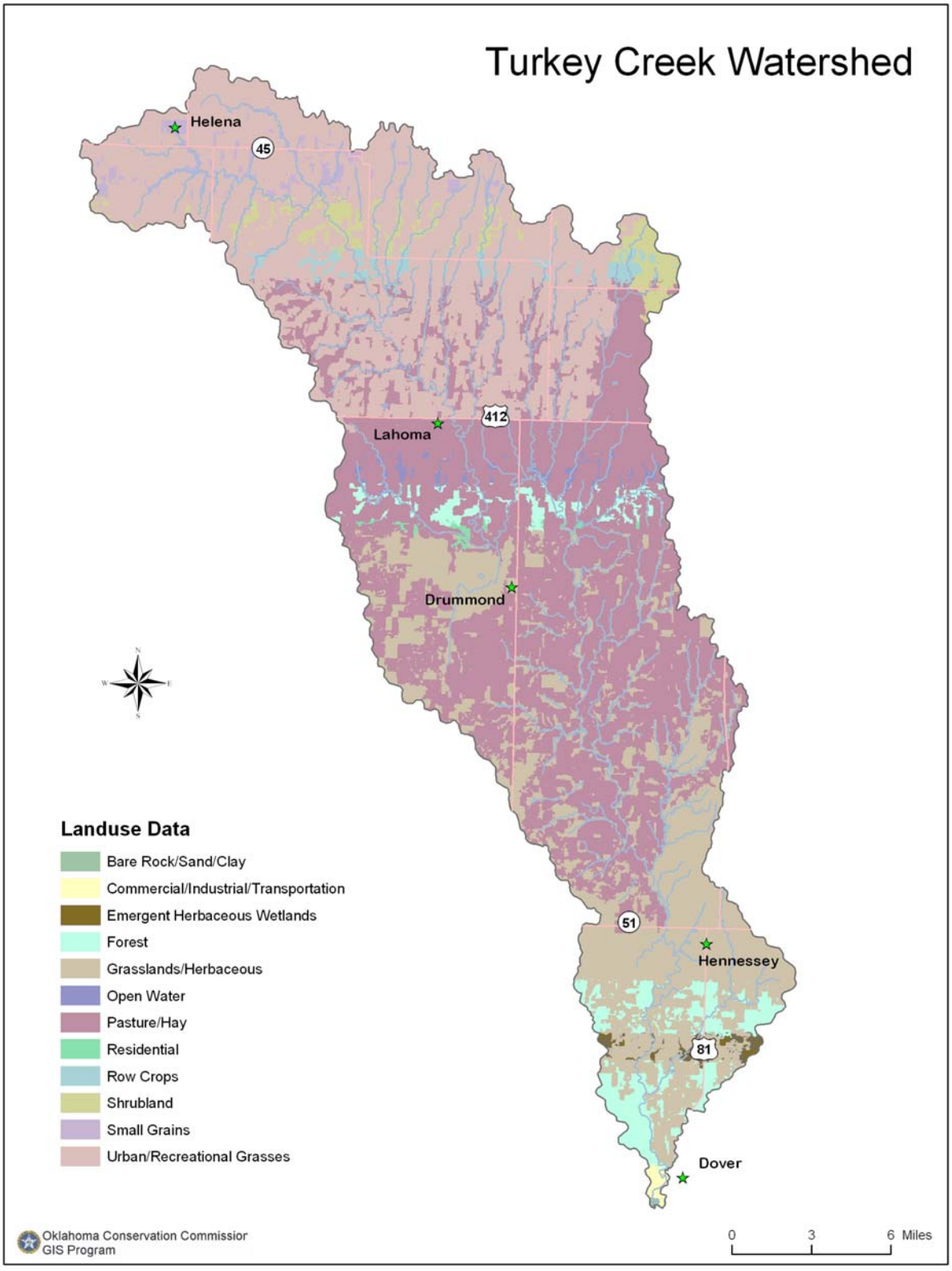

Figure 2. Landuse in the Turkey Creek Watershed.

1) **Build a sound environmental basis to address the impairment of streams in North Central Oklahoma**. Activities to address Nonpoint Source Pollution in the region need to be based on sound and current data identifying the problems in the stream, the *Causes* (pollutants) and the categorical and geographical *Sources* causing problems in the stream. This project focused on Turkey Creek as representative of the streams in this region. The objectives were to look at the evaluated data and determine the extent of the problem(s) originally identified in the 1988 Nonpoint Assessment Report. This was accomplished by conducting monthly water quality monitoring, habitat assessments along with biological collections. This was crucial because the 1988 assessment data was older than 10 years. Additional data collection was also necessary to insure that additional water quality problems did not exist that had gone un-noticed. Since suspended solids and siltation were also identified as water quality concerns, the stability and classification of the stream was determined based on the Rosgen Method. A watershed reconnaissance was accomplished **to identify the potential land use activities that could be contributing to the water quality problems of Turkey Creek**. This information was input into the Commission's GIS system for potential analysis of the most critical source areas.
2) **Build a local programming base for addressing nonpoint source problems** in the creeks of North Central Oklahoma which exhibit problems similar to Turkey Creek. Concurrent to the activities outlined under objective 1), establish a steering committee to help direct the objectives of the program. This steering committee should be informed of the problems that have previously been identified in Turkey Creek along with updates of information collected as a part of the monitoring portion of this project. This steering committee should help to build landowner and land user support within the project area.

Phase II of the project within this workplan was the implementation of the demonstration watershed. This phase was included such that additional money may be requested in later workplans to complete implementation as determined by the completion of the implementation plan. A small representative watershed was identified and selected to demonstrate how effective land use management can correct suspended sediment and siltation problems. An implementation plan for the demonstration watershed was to be developed and submitted as a project output. This plan would summarize the list of eligible practices, components of the practice, along with the incentive rates.

Project Activity: Pre-Project Survey

An important part of this project is determining the acceptance of landowners to alter the way they manage their lands. To determine this, landowners were surveyed about their attitudes toward the land and water and their willingness to adopt new, additional management practices or change the current way they manage their lands. The purpose of this survey was to establish the pre- project condition of the area and to acquire information to formulate the best strategies for addressing nonpoint source pollutants in the area. A sociologist with Oklahoma State University was consulted for the design of the survey and data analysis. This was a new direction taken by the State in an attempt to best utilize the available funds and to address the needs of the local landowners in a way to insure the success of this project.

Pre-Project Survey Results:

Three data gathering methods were chosen to ascertain the acceptance of landowners to new management techniques. These included a county fair attendee survey, a vocational agriculture parent/neighbor survey, and focus groups of local residents and professionals. The county fair survey consisted of five questions that could be answered by attendees who stopped at the Kingfisher and Garfield Counties' Conservation District booths. Forty-four county fair surveys were completed. The Vo-Ag Parent/Neighbor survey included 22 questions that were distributed by local Vo-Ag teachers to local FFA chapters. FFA members took the surveys home for parents to fill out as well as to at least one adult neighbor to fill out. This effort resulted in 237 usable surveys.

In addition, six focus groups and one long interview were conducted to provide data which would describe in greater detail the needs and perceived water quality problems and solutions as described by local residents. The six focus groups included the League of Women Voters, high school students, agricultural producers, Conservation District Board members, Cooperative Extension Service personnel, and NRCS personnel. The long interview was used to gather data from a member of the local wildlife conservation chapter. Three key issues were considered by the focus groups, including : 1) what water quality concerns are you aware of involving surface water, ground water, and/or drinking water, 2) what sources of pollution are you aware of involving surface water, ground water, and / or drinking water, and 3) what are the solutions to these pollution problems?

The low number of county fair surveys relative to the other groups caused it to be given little emphasis for conclusions and recommendations. According to the other two data collection efforts, people are willing to adopt new practices to protect their water quality, however producers want economic information about the adoption of new practices for consideration. If economic benefits (or at least lack of economic detriments) cannot be demonstrated relative to the practices, farmers will not be willing and/or able to implement them. The groups were conflicted over whether or not substantial changes had occurred in Turkey Creek over time; focus groups agreed that it had changed drastically in the last few years, but the Vo-Ag survey was split between changes and lack of changes. Non-ag residents, however, did feel that the creek had degraded significantly over time. Some residents perceived problems with their drinking water.

Ag. Producers utilitze a wide variety of techniques to determine when and what type of pesticide to use in their production. Integrated Pest Management was not a strategy that seemed to be employed in the watershed.

Soil testing appeared to be fairly widespread in the watershed, however, it was not completed on a regular basis. Producers appeared to rely on test results for multiple years. Ag producers did appear to believe in the value of BMPs; however, certain BMPs lacked widespread support. BMPs that producers did not favor included windbreaks and shelterbelts and restricting livestock access to streams. However, several producers felt it was important that farmland along creeks should be converted to pasture.

Adults in the watershed seemed to believe that the best way educate adults in the watershed is through and with the children. However, due to the sensitivity of watershed residents to topics such as flooding and hog farms, any water quality educational programs and perhaps any other programs in the watershed would need to address these issues or at least explain why they weren't addressing these issues in order to gain acceptance with local citizens. Any program focused towards agricultural producers should similarly address waste dumping and streambank management.

A complete summary of the pre-project survey can be seen in Appendix A.

Project Activity: Establish Baseline Water Quality Information to Characterize Turkey Creek System

Activities of this project are based on addressing the NPS causes that threaten the attainment of the beneficial uses of Turkey Creek and the Cimarron River Downstream. Data available on Turkey Creek in the 1988 319 Assessment Report was listed as evaluated in nature and does not indicate any specific sources. The approach to achieving success with this project will be based on implementing different phases of the project during different grant cycles.

Early in the project, OCC worked to verify the current level of non-support of the in-stream beneficial uses, verify the causes of non-attainment, identify the source of pollutants, and then target areas for demonstration and education programs (Figure 3). This activity established a baseline of water quality, aquatic habitat, and biological information to characterize the Turkey Creek system. These data could then be used for later comparison when BMPs and pollution prevention measures have been installed and evaluated for their effectiveness.

Six sites were monitored for beneficial use attainment (Figure 4). Three sites on Turkey Creek, were monitored in addition to Buffalo Creek, Clear Creek and Little Turkey Creek. Parameters tracked included dissolved oxygen, pH, conductivity, turbidity, chlorides, sulfates, total dissolved solids, nutrients, and fecal coliform bacteria. Additionally, biological samples of fish, macroinvertebrates, and periphyton were collected at these sites.

Water Quality Summary:

Dissolved oxygen medians were lowest for Buffalo Creek at 7.28 mg/l (Table 1). While the median meets the levels established in the Oklahoma Administrative Code 785:45-46, three individual samples fell below the established level of 4.0 mg/l from June 16 through October 15 and 5.0 mg/l for the remainder of the year (OAC 785:46-15-5). Buffalo Creek's dissolved oxygen was well below 4.0 mg/l when it reached 1.79 mg/l on 7/22/1998 and was even lower at 0.46 mg/l on 9/30/1998 (Appendix B). It was also lower than that allowed on 5/19/1998 when it measured 4.71 mg/l (Appendix B).

Figure 3. Turkey Creek

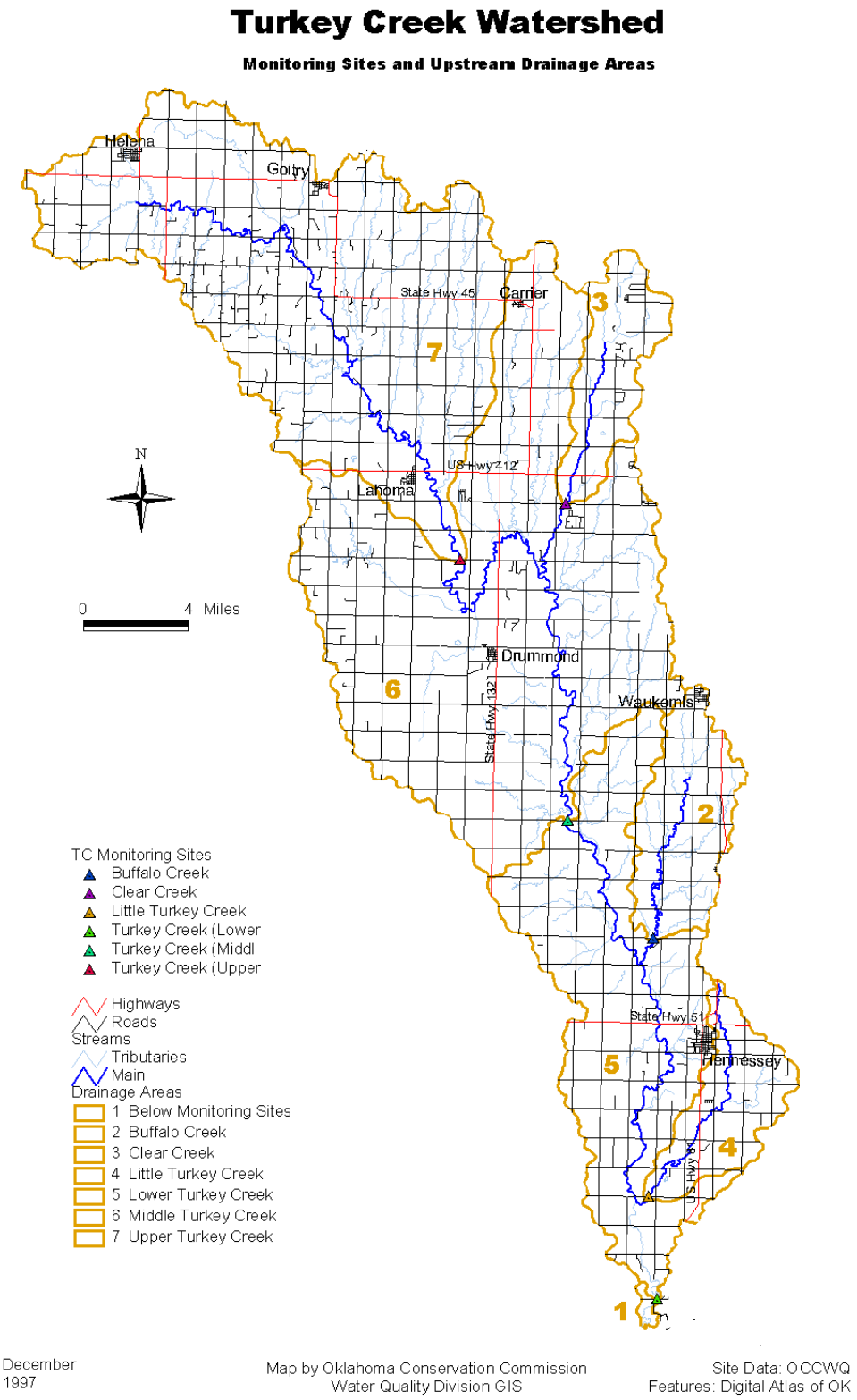

Figure 4. Monitoring Sites in Turkey Creek Watershed.

The medians for pH at the study sites ranged from 7.97 at both the upper site on Turkey Creek and Little Turkey Creek to 8.2 at the middle site on Turkey Creek (Table 1). These values fall well within the range of 6.5 and 9.0 established for protection of fish and wildlife in the Oklahoma Administrative Code 785:45-5-12.

Turbidity medians were highest for the lower site of Turkey Creek at 68 NTU (Table 1). This exceeds the 50 NTU turbidity level established in the OAC 785:45-46. The sites with the lowest turbidity were Little Turkey Creek at 5.81 NTU and Clear Creek at 6.86 NTU (Table 1). The other three sites exceeded 50 NTU in turbidity periodically with the upper site on Turkey Creek having a median of 46.2 NTU, the middle Turkey Creek site having one of 29.3 NTU and Buffalo Creek reporting 35.5 NTU (Table 1).

All sites were below the required levels for chlorides, sulfates, and total dissolved solids. The levels for chlorides were to be at or below an annual mean of 4568.00 mg/l. Chloride results for all the sites were well below this value (Table 1). The site with the highest mean was the middle site on Turkey Creek at 204.08 mg/l. Clear Creek's mean was the lowest at 75.25 mg/l. In a similar manner, sulfate levels were to be at or below an annual mean of 730.00 mg/l. While Clear Creek again sponsored the lowest mean at 51.81 mg/l, Buffalo Creek reported the highest annual mean at 142.07 mg/l (Table 1). Finally, total dissolved solids had a limit of the annual mean at or below 9042.00 mg/l. Buffalo Creek again had the highest annual mean at 1072.30 mg/l and Clear Creek had the lowest at 581.79 mg/l (Table 1).

Phosphorus levels on Turkey Creek were highest at the upstream site and decreased downstream. Nitrite plus nitrate did not follow the same trend; the middle site was higher at 2.252 mg/l followed by the lower (2.165 mg/l) with the upper site registering less at 2.10 mg/l (Table 2). The highest total phosphorous levels were found at the upper site on Turkey Creek with a mean of 0.475 mg/l (Table 2). Little Turkey Creek had the lowest total phosphorous level with a mean of 0.141 mg/l and the highest levels of total nitrogen with a mean of 8.080 mg/l and median of 7.924 mg/l (Table 2). Buffalo Creek had the lowest levels of total nitrogen with a mean of 2.807 mg/l and a median of 2.071 mg/l (Table 2). All water quality data can be found in Appendix B.

The upper site on Turkey Creek sponsored the largest fecal coliform bacteria values with an annual mean of 17176.92 colonies per 100 ml (Table 3). During the primary body contact recreation period (May 1 through September 30), this site had a mean of 28233.33 colonies per 100 ml (Table 3). The fecal coliform values decreased as Turkey Creek flowed downstream with the lower site hosting an annual fecal coliform mean of 2798.33 colonies per 100 ml and a mean of 1560.00 colonies per 100 ml during the primary body contact recreation period (Table 3). Clear Creek had high fecal coliform means both annually (9410.83 colonies per 100 ml) and for the primary body contact recreation period (15916.67 colonies per 100 ml) (Table 3). Buffalo Creek had the lowest annual mean of 1786.67 colonies per 100 ml, but Little Turkey Creek had the lowest mean for the primary body contact recreation period at 924.60 colonies per 100 ml (Table 3). All fecal coliform bacteria data can be found in Appendix C.

Table 1: Descriptive Statistics of Water Quality Parameters.

Site	DO mg/l	pH SU	Cond µg/cm	Temp C	Turb NTU	Alk mg/l	Chloride mg/l	Sulfate mg/l	Tot Hard mg/l	TDS mg/l	TSS mg/l
Turkey Creek (lower)											
Mean	8.44	8.13	1317.75	15.75	199.27	275.25	170.50	98.60	310.33	908.22	240.79
Median	8.82	8.18	1464.00	16.90	68.00	283.50	184.50	114.50	306.00	966.24	64.50
Standard Deviation	2.94	0.20	447.12	8.45	341.24	98.68	63.61	36.68	104.72	191.25	600.87
N	13	11	13	13	13	12	12	12	12	11	12
Turkey Creek (middle)											
Mean	9.85	8.16	1413.33	17.45	217.76	277.23	204.07	104.93	295.92	1049.80	182.49
Median	9.89	8.20	1563.00	18.10	29.30	275.00	225.00	117.00	290.00	1089.00	39.80
Standard Deviation	2.12	0.30	520.57	9.71	491.76	108.80	84.63	37.89	113.44	188.85	367.38
N	13	12	13	13	13	13	13	13	13	11	13
Turkey Creek (upper)											
Mean	8.66	7.91	1236.56	18.22	194.59	303.08	154.94	74.50	288.00	881.96	153.62
Median	9.22	7.97	1336.00	18.70	46.20	295.00	173.00	82.50	286.00	947.10	58.65
Standard Deviation	2.86	0.30	435.22	8.97	328.19	115.65	66.66	30.57	110.94	228.45	262.95
N	13	11	13	13	13	13	12	12	12	10	12
Little Turkey Creek											
Mean	9.52	7.90	7.90	15.53	82.06	199.42	97.95	57.79	272.73	614.06	127.27
Median	9.01	7.97	846.50	17.40	5.81	218.50	113.00	54.40	300.00	607.20	5.50
Standard Deviation	1.59	0.34	285.91	6.82	220.61	57.57	38.39	41.47	74.68	122.13	400.92
N	12	10	12	12	12	12	11	11	11	10	11
Buffalo Creek											
Mean	7.41	7.82	1577.76	16.85	393.97	382.50	155.87	142.07	357.92	1072.30	152.18
Median	7.28	8.01	1814.00	20.70	35.50	456.50	185.50	163.50	419.50	1197.20	35.40
Standard Deviation	3.75	0.55	721.68	8.81	944.38	168.92	88.47	71.15	152.32	376.68	327.66
N	13	11	13	13	13	12	12	12	12	11	12
Clear Creek											
Mean	10.11	8.18	744.15	20.79	342.74	222.46	75.25	51.81	237.42	581.79	125.10
Median	11.07	8.14	807.00	24.50	6.86	247.00	77.25	49.05	260.00	568.26	9.90
Standard Deviation	1.95	0.31	299.81	11.35	978.09	87.72	30.04	25.12	62.83	57.40	311.04
N	13	11	13	13	13	13	12	12	12	10	12

Water column periphyton samples were collected in the summer of 1998. These chlorophyll-a numbers tended to be high on both the Turkey Creek lower (15.21 to 24.47 μg/l) and upper sites (17.00 to 20.58 μg/l) (Table 4). Clear Creek water column chlorophyll-a samples were also higher than the reference condition ranging from 8.71 to 15.57 μg/l (Table 4). The chlorophyll-a water column periphyton samples from the Turkey Creek middle site (2.31 to 6.22 μg/l) and Little Turkey Creek (2.24 to 2.91 μg/l) were similar to those from the reference sites on Griever Creek (3.72 to 6.64 μg/l) and the unnamed tributary to the South Canadian River (2.71 to 4.22 μg/l) (Table 4). Red Rock Creek was sampled once for water column periphyton, resulting in a relatively high result of 24.97 μg/l chlorophyll-a (Table 4). Buffalo Creek stood out with extremely high chlorophyll-a results ranging from 50.58 to 208.16 μg/l (Table 4). This situation should be assessed to determine if sewage from nearby communities could be contributing to this abundance of algae on Buffalo Creek.

Periphytometer samples were taken in the spring and summer of 1998. The reference conditions at Red Rock Creek (0.93 to 1.02 μg/l chlorophyll-a) and Griever Creek (2.07 to 3.93 μg/l chlorophyll-a) were low (Table 4). That found at the unnamed tributary to the South Canadian River was acceptable but still high ranging from 7.85 to 8.27 μg/l chlorophyll-a (Table 4). Buffalo Creek sponsored the highest chlorophyll-a values with most ranging from 12.163 to 18.341 μg/l (Table 4). One reading of 0.567 μg/l chlorophyll-a was also recorded (Table 4); the accompanying field notes indicated that the rods had very sparse growth. This could be due to exposure to herbicide, grazing by a stoneroller (*Campostoma anomalum*), or turbid or shady periphytometer placement. The lower site on Turkey Creek also sponsored somewhat high chlorophyll-a levels ranging from 8.357 to 16.959 μg/l (Table 4). The remaining sites did not have alarming chlorophyll-a values, with all falling into an acceptable level.

Table 2: Descriptive Statistics for Nutrient Parameters.

Site	Total Phos mg/l	Total Ortho-Phos mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Total N mg/l	NH_3 mg/l
Turkey Creek (lower)							
Mean	0.365	0.177	2.140	0.025	1.164	3.219	0.123
Median	0.273	0.180	2.040	0.021	0.780	3.118	0.092
Standard Deviation	0.258	0.082	1.069	0.019	0.927	0.830	0.125
N	12	12	12	12	12	11	12
Turkey Creek (middle)							
Mean	0.456	0.217	2.230	0.022	1.133	3.068	0.104
Median	0.279	0.200	2.130	0.019	0.610	3.130	0.057
Standard Deviation	0.451	0.104	0.960	0.016	1.218	0.862	0.133
N	13	13	13	13	13	11	13
Turkey Creek (upper)							
Mean	0.475	0.291	2.001	0.099	1.529	3.331	0.321
Median	0.455	0.267	1.870	0.042	0.925	3.344	0.145
Standard Deviation	0.250	0.135	0.680	0.104	1.127	0.635	0.340
N	12	12	12	12	12	10	12
Little Turkey Creek							
Mean	0.141	0.063	6.883	0.051	0.770	8.080	0.143
Median	0.097	0.054	7.240	0.054	0.570	7.924	0.044
Standard Deviation	0.178	0.039	2.260	0.024	0.800	1.065	0.224
N	11	11	11	11	11	10	11
Buffalo Creek							
Mean	0.325	0.155	1.764	0.044	1.070	2.807	0.123
Median	0.284	0.145	1.150	0.021	0.845	2.071	0.087
Standard Deviation	0.234	0.114	1.525	0.082	0.757	1.632	0.119
N	12	12	12	12	12	11	12
Clear Creek							
Mean	0.227	0.120	2.624	0.019	0.813	3.284	0.081
Median	0.143	0.091	2.855	0.016	0.515	3.820	0.037
Standard Deviation	0.208	0.056	1.470	0.009	0.842	1.484	0.164
N	12	12	12	12	12	10	12

Table 3: Descriptive Statistics for Fecal Coliform Bacteria.

Site	Annual Mean Col/100 ml	Annual Median Col/100 ml	Standard Deviation	PBCR Mean Col/100 ml	PBCR Median Col/100 ml	PBCR Standard Deviation
Turkey Creek (Lower)	2798.33	215.00	6818.00	1560.00	1200.00	1988.22
Turkey Creek (Middle)	4695.71	215.00	10746.86	5766.67	600.00	11919.34
Turkey Creek (Upper)	17176.92	800.00	45003.74	28233.33	1900.00	64578.81
Little Turkey Creek	2609.36	400.00	6485.14	924.60	400.00	1192.28
Buffalo Creek	1786.67	650.00	2478.48	1360.00	1100.00	1258.17
Clear Creek	9410.83	800.00	25630.12	15916.67	1050.00	36308.04

Table 4: Chlorophyll-a from Periphytometers and Water Column.

Site	Sample	Date	Periphytometer Chl-a Mean	Standard Dev	Standard Error	Water Column Chl-a Mean
Turkey Creek (lower)	6963	7/28/1998	10.478	4.402	1.360	15.209
	6964	8/10/1998	8.357	1.914	0.662	24.467
	6966	8/26/1998	9.172	0.857	0.283	16.263
	14198	3/4/1998	16.959	6.010	1.459	--
Turkey Creek (middle)	6979	7/28/1998	6.182	--	--	6.221
	6980	8/12/1998	2.690	0.871	0.531	4.012
	6982	8/26/1998	5.118	0.973	0.430	2.308
	14201	3/4/1998	3.951	0.920	0.463	--
Turkey Creek (upper)	6993	7/28/1998	5.041	2.101	0.936	20.578
	6994	8/12/1998	7.051	1.988	0.749	20.298
	6996	8/26/1998	8.875	1.764	0.592	17.001
	14204	3/4/1998	8.711	1.939	0.657	
Little Turkey Creek	7007	7/28/1998	--	--	--	2.914
	7008	8/12/1998	--	--	--	2.699
	7010	8/26/1998	2.026	0.409	0.287	2.243
	14207	3/4/1998	9.166	1.558	0.515	--
Buffalo Creek	7022	7/28/1998	18.341	1.526	0.356	50.575
	7023	8/12/1998	13.460	0.804	0.219	208.157
	7025	8/26/1998	12.163	1.238	0.355	71.204
	14210	3/4/1998	0.567	0.196	0.260	--
Clear Creek	7037	7/28/1998	5.665	2.871	1.206	12.780
	7038	8/11/1998	--	--	--	8.711
	7040	8/26/1998	--	--	--	15.567
	14213	3/4/1998	9.573	0.746	0.241	--
Griever Creek	7048	7/26/1998	3.928	1.207	0.609	6.637
	7049	8/10/1998	2.073	0.732	0.509	3.719
Unnamed Tributary to	7078	7/26/1998	8.172	2.717	0.950	2.729
the South Canadian	7081	8/23/1998	7.852	1.303	0.465	2.712
River	14221	8/10/1998	8.271	1.368	0.476	4.223
Red Rock Creek	7068	8/10/1998	1.015	0.284	0.282	24.971
	7070	8/24/1998	0.930	0.152	0.158	--

Beneficial Use Assessment:

None of the sites met all beneficial uses assigned to it (Table 5). While all sites met the agricultural and industrial beneficial uses (Table 6), no sites met the primary contact beneficial use and all sites but two sites failed the fish and wildlife propagation beneficial use. Although data was not collected for either *Escherichia coli* or Enterococci, none of the sites met the assessment for primary body contact as all sites exceeded the fecal coliform screening level. The upper site on Turkey Creek and Clear Creek exceeded 400 colonies/100 ml 66.7% of the time. The lower site on Turkey Creek and Buffalo Creek exceeded this criterion 60% of the time. The middle site on Turkey Creek had 50% of the readings exceeding the criteria while Little Turkey exceeded only 40% of the time. All sites on Turkey Creek partially met the public and private water supply beneficial use.

Table 5: All Assigned Beneficial Uses.

Site	WBID	Ag	Industry	PBCR	FWP: WWAC	PPWS
Turkey Lower	OK620910-06-0010B	Meets	Meets	Not meet	Not meet	Partially meets
Turkey Middle	OK620910-06-0010M	Meets	Meets	Not meet	Not meet	Partially meets
Turkey Upper	OK620910-06-0010U	Meets	Meets	Not meet	Not meet	Partially meets
Little Turkey	OK620910-06-0020B	Meets	Meets	Not meet	Partially meets	-
Buffalo Creek	OK620910-06-0030G	Meets	Meets	Not meet	Not meet	-
Clear Creek	OK620910-06-0110G	Meets	Meets	Not meet	Partially meets	-

-Not a designated use

Table 6: Agriculture and Industry Beneficial Uses.

AGRICULTURE/INDUSTRY			
	Chloride	Sulfate	TDS
Turkey Lower	Meets	Meets	Meets
Turkey Middle	Meets	Meets	Meets
Turkey Upper	Meets	Meets	Meets
Little Turkey	Meets	Meets	Meets
Buffalo Creek	Meets	Meets	Meets
Clear Creek	Meets	Meets	Meets

Toxics were not tested for the Fish and Wildlife Propagation beneficial use. All sites met the screening levels for pH and oil and grease (Table 7). The dissolved oxygen concentration in Buffalo Creek fell below 2 mg/l on two separate occasions contributing to its not meeting the fish and wildlife propagation warm water aquatic community beneficial use category as established in the Continuing Process Plan. It failed the dissolved oxygen requirement 23% of the time. Turbidity levels during base flow conditions were to be at or below 50 NTU for these sites. Both Little Turkey Creek and Clear Creek met this screening level. Turbidity at Buffalo Creek and Turkey Creek at the lower and upper sites exceeded 50 NTU. Buffalo Creek exceeded this limit 36.4% of the time. Turkey Creek at the upper site exceeded 30.0% of the time, and at the lower site 54.5% of the time. Turkey Creek at the middle site partially met the turbidity screening level by exceeding only 18.2% of the time.

Fish collections at all sites did not differ markedly from the reference sites. Clear Creek and Little Turkey Creek achieved 102.6% of the composite reference condition found in Griever Creek and an unnamed tributary to the South Canadian River. Turkey Creek at the upper site fish collections reflected 92% of this reference condition. Turkey Creek at the middle and lower sites both achieved 100% of the composite reference condition found in Otter Creek, Red Rock Creek, and Sandy Creek. The fish collection in Buffalo Creek exceeded the composite reference condition score at 106.5%. All the data from the fish analyses can be found in Appendix D.

While the fish collections did not indicate problems, macroinvertebrate collections yielded different results. Buffalo Creek, Clear Creek, Little Turkey Creek and Turkey Creek at the middle site all achieved at least 80% of the reference condition for both winter and summer macroinvertebrate collections. Turkey Creek at both the upper and lower sites, however, did not reflect reference conditions as favorably. The upper site at Turkey Creek achieved the reference condition in the winter collections. While the summer riffle collection exceeded the reference condition at 107.7%, both the woody and vegetative collections were much less (66.7% and 41.2% respectively) indicating a community structure less than expected. The lower site at Turkey Creek indicated problems through both the winter and summer collections. Winter riffle collections reached only 61.5% of reference conditions while the woody collection attained only 53.3% of the reference. The woody habitat was the sole habitat available for sampling in the summer. This collection reached only 17.6% of the composite reference condition. This indicates that fewer species are present than the reference condition. Those species present are more tolerant to poor habitat and water quality. All macroinvertebrate analyses data can be found in Appendix E.

Table 7: Fish and Wildlife Propagation Beneficial Use.

Fish and Wildlife Propagation						
	DO	**pH**	**Oil & Grease**	**Biocriteria**	**Toxics***	**Turbidity**
Turkey Lower	Meets	Meets	Meets	Not meet	Meets	Not meet
Turkey Middle	Meets	Meets	Meets	Meets	Meets	Partially meets
Turkey Upper	Meets	Meets	Meets	Not meet	Meets	Not meet
Little Turkey	Meets	Meets	Meets	Meets	Meets	Meets
Buffalo Creek	Not meet	Meets	Meets	Meets	Meets	Not meet
Clear Creek	Meets	Meets	Meets	Meets	Meets	Meets

*Not assessed

The public and private water supply beneficial use category was not assigned to the sites on Little Turkey Creek, Buffalo Creek, or Clear Creek. Toxicants were not assessed for this beneficial use. All three sites on Turkey Creek partially met the fecal coliform levels (Table 8). The lower site exceeded the level 16.7% of the time, the middle exceeded the level 14.3% of the time and the upper site exceeded 23.1% of the time. As all exceeded less than 25% of the time, all sites partially met this beneficial use.

Table 8: Public and Private Water Supply Beneficial Use.

PPWS		
	Toxicants*	**Bacteria (Fecal Coliform)**
Turkey Lower	Meets	Partially meets
Turkey Middle	Meets	Partially meets
Turkey Upper	Meets	Partially meets
*Not assessed		

Clear Creek and Little Turkey Creek are both threatened by nutrients. Total phosphorous at Clear Creek averaged 0.23 mg/l and nitrite plus nitrate was 2.64 mg/l (Table 2). As turbidity was less than 20 NTU, this stream falls into the nutrient threatened category. Nitrite plus nitrate for Little Turkey Creek registered 6.93 mg/l (Table 2). With turbidity levels less than 20 NTU, Little Turkey Creek also is nutrient threatened. The other sites were not threatened by nutrients.

High flow events again indicated increased nutrient and sediment at the study sites. Total suspended solids on Turkey Creek ranged from 259 to 2145 mg/l over two high flow events, while total phosphorous ranged from 0.72 to 1.80 mg/l over this same period. Little Turkey Creek had a total suspended solids level of 1336 mg/l and a total phosphorous of 0.67 mg/l for its single high flow event. Buffalo Creek registered 1168 mg/l total suspended solids and 0.79 mg/l total phosphorous during its high flow event. Clear Creek had two high flow events. During the first, the total suspended solids were 1067 mg/l; those for the second were 335 mg/l. Total phosphorous for the first event was 0.77 mg/l and for the second was 0.523 mg/l. Levels of both total suspended solids and total phosphorous were both elevated from levels found during base flow conditions. This water quality data can be found in Appendix B.

Water Quality Summary:

Turkey Creek, Buffalo Creek, Clear Creek, and Little Turkey Creek are all impacted by fecal coliform bacteria. Turbidity is also impacting these sites. Lowered dissolved oxygen levels are impacting Buffalo Creek. Toxicants, *E. coli* and enterococci should be tested to determine what contribution they might have to the situation. Macroinvertebrate collections are indicating a problem in both upper and lower sites of the Turkey Creek system.

Watershed Reconnaissance Summary:

A watershed reconnaissance was completed to identify the potential land use activities that could be contributing to the water quality problems of Turkey Creek. This information was input into the Oklahoma Conservation Commission's (OCC) GIS system for potential analysis of the most critical source areas.

To complete the watershed reconnaissance, it was determined that a minimum of 10% of stream frontage land (both sides of stream) would be surveyed along the main stem of Turkey Creek and two randomly selected tributaries (Spring, Little Turkey). The District Manager at Kingfisher County (Steve Winters) would complete the reconnaissance by beginning at river mile 5 and

moving north 10 stream miles as available until at least 10% of stream frontage land was assessed. On Spring Creek, assessment would begin at river mile 1 and assess for 0.3 miles every 3rd mile. On Little Turkey Creek, assessment would begin at river mile 0.2 and assess for every 0.3 miles every 3rd mile.

Information collected and evaluated during the reconnaissance included:

- based on the aerial photograph of the area, split the land up into major management areas and designate landuse of those areas
- describe the # of cattle on each management section by #of head/season
- amount of nitrogen fertilizer per acre
- amount of phosphorus fertilizer per acre
- locate tile drain systems & designate on aerial
- locate septic tanks & designate on aerial

The following questions were then to be answered by Steve or other District technical staff:

- How many rods of fence would it take to help manage cattle access to the stream
- Would an alternative water source be needed if yes to above? How many?
- Would stream crossings be needed if yes to above? How many
- Badly eroding streambanks in need of stabilization? Map

Figure 5.illustrates the location and extent of these assessments while Figure 6 displays a detailed image of the types of information recorded from these assessments. These assessments were conducted to further delineate sources most likely to be contributing to water quality problems in Turkey Creek. The results of the assessments suggested that lack of protected riparian buffer area, cattle traffic, inappropriately located septic systems, roadside erosion, and other factors likely contributed to sediment, nutrient, and bacteria loads in Turkey Creek and its tributaries. These problems suggested that BMPs such as riparian zone enhancement and protection, grazing management, nutrient management, and wetland development might be among the appropriate BMPs for the watershed.

In addition to the reconnaissance, the stability and classification of Turkey Creek was assessed using the “Rosgen” level 4 technique. This included establishing permanent transects at some sites and bank pins at other stream sites to monitor stream bank erosion. Stream stability and changes in meanders were assessed through the review of aerial photographs and comparison of old USGS streambed elevation data. Hydrological characteristics were based on the 23 years on USGS flow monitoring from 1947 through 1970 at Dover. Based on this classification, Turkey Creek is an E5 or E6 type channel. According to Rosgen (1998), “the E5 stream types are channel systems with low to moderate sinuosities, gentle to moderately steep channel gradients, and very low channel width/depth ratios. The E5 channels are narrow and relatively deep and are hydraulically efficient with a high sediment transport capacity. The E5 stream channels are very stable unless the streambanks are disturbed, and significant changes in sediment supply and streamflow occur.” E6 channels are very similar to E5 channels in that they are very stable unless streambanks are disturbed.

This classification suggests that protection and stability of streambanks is key to water quality protection in the Turkey Creek Watershed. Therefore, riparian area establishment should be a critical portion of remedial efforts in the Turkey Creek Watershed.

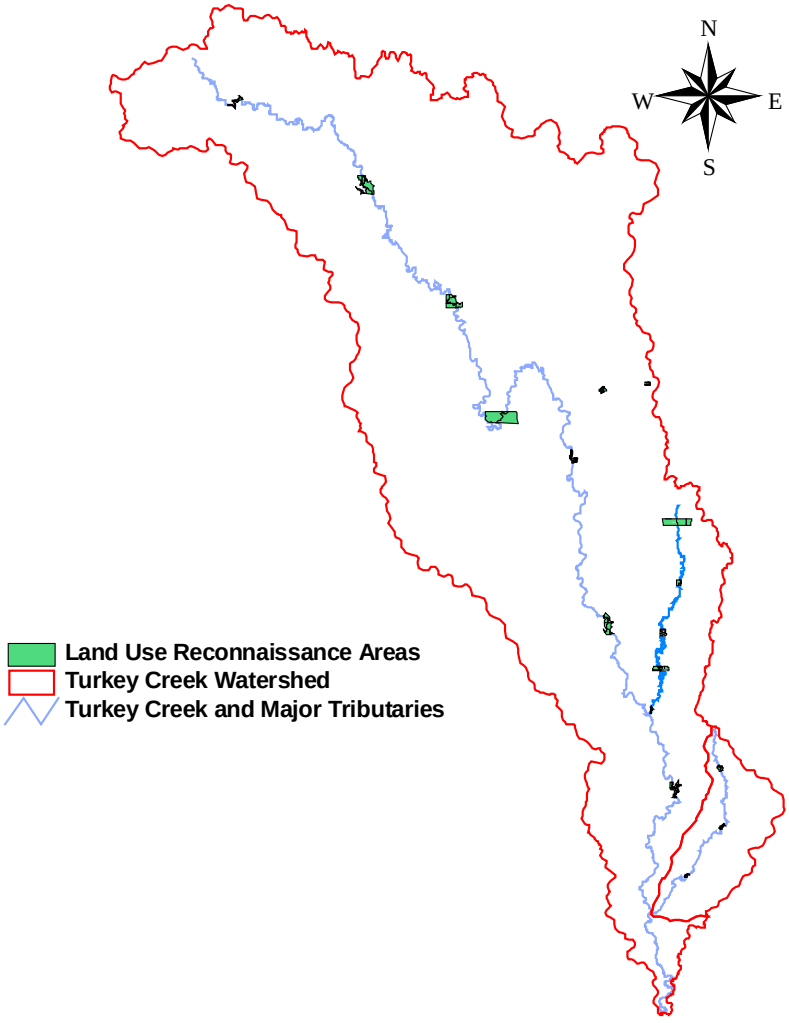

Figure 5. Land Use Reconnaissance Areas in the Turkey Creek Watershed.

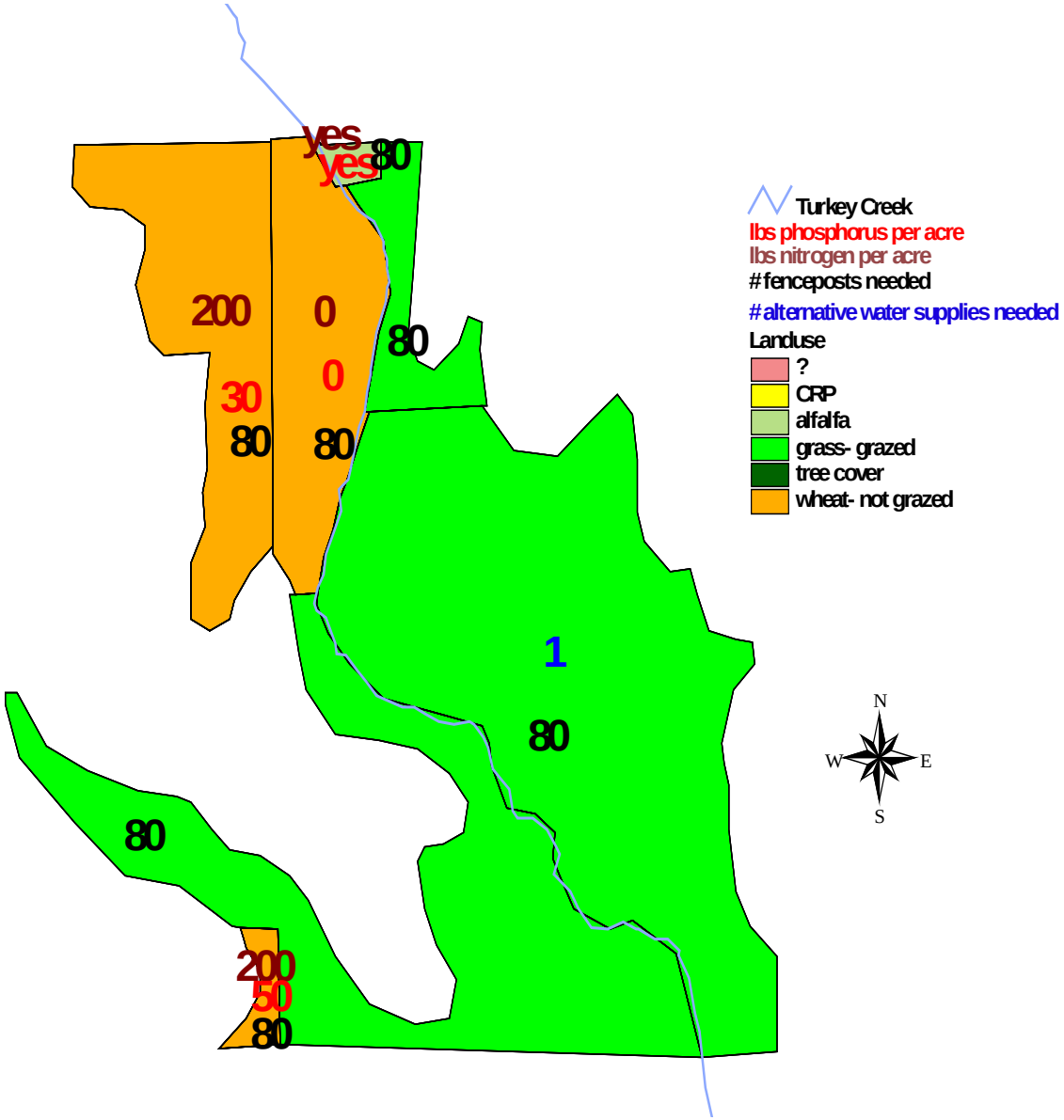

Figure 6. Detail of Reconnaissance in Turkey Creek Watershed.

Turkey Creek Rosgen Classification

Turkey Creek Water Quality Monitoring Sites

Gauge Station Name	USGS Station #	Location	County	Drainage Area, mi^2	Estimated Bankfull Data					Classification Data					Stream Type
					Flow, cfs	R.I., yrs	Width, ft	Depth, ft	Area, ft^2	W/D	Entr.	Sin. 1	Sin. 2	Slope, ft/ft	
Buffalo Creek		n.b. 3-19N-7W	Kingfisher	22.9			24.8	3.4	84.6	7.3	6.0	1.3	1.1	0.002230	E6
Clear Creek		n.b. 19-22N-7W	Garfield	18.0			28.3	3.3	92.7	8.7	8.5	1.2	1.1	0.001809	E5
Little Turkey Creek		NE 22-18N-7W	Kingfisher	18.0			26.2	2.8	72.3	9.5	2.1	1.2	1.1	0.002080	E5
Upper Turkey Creek		n.b. 33-22N-8W	Garfield	133.1			45.4	5.8	263.7	7.8	34.8	1.7	1.0	0.000843	E5 or E6
Middle Turkey Creek		n.b. 18-20N-7W	Garfield	302.0			76.7	9.3	710.0	8.3	6.4	1.4	1.1	0.000720	E5
Lower Turkey Creek		NW 2-17N-7W	Kingfisher	416.0			108.9	8.1	877.1	13.5	4.1	1.6	1.1	0.000237	**C5** or E5
Un-named trib. Blw Site 10		SE 27-23N-9W	Major	2.8			16.3	1.5	24.6	10.8	4.7	1.4		0.000213	E6

Regional USGS Gauging Stations

Gauge Station Name	USGS Station #	Location	County	Drainage Area, mi^2	Estimated Bankfull Data					Classification Data					Stream Type
					Flow, cfs	R.I., yrs	Width, ft	Depth, ft	Area, ft^2	W/D	Entr.	Sin. 1	Sin. 2	Slope, ft/ft	
Turkey Creek nr Drummond, OK	07159000	NE 12-21N-8W	Garfield	248.0	1600	1.42	56.7	8.4	477.2	6.8	12.7	1.4		0.001080	E1
Turkey Cr trib nr Goltry, OK	07158550	SW 11-23N-9W	Alfalfa	5.1	Estimated Bankfull Data										
N. Canadian R. trib nr Eagle City	07239050	NE 28-17N-13W	Blaine	0.5	45	1.36	11.6	0.75	8.75	15.4	2.1			0.0409	B4
Rough Creek upstream from gauge	07228290	SW 3-15N-15W	Custer	9.3	210	1.2	23.2	3	69	7.7				0.0011	E5
Rough Creek nr Thomas	07228290	SW 3-15N-15W	Custer	10.4	240	1.2	27	3	81.5	8.9	1.9			0.0011	E5

Notes:

Sin. 1 = Sinuosity measured on 1:24,000 topo quad

Sin. 2 = Sinuosity measured on aerial photo

Project Activity: Establish Local Advisory Group

Activity Description:

Establish a local advisory group to help guide the direction of the program. This group was made up of representatives of conservation groups, commodity groups, and local leaders. This group was to be involved in the early stages of the project including regular updates of water quality information, participation in field activities to demonstrate the various nonpoint sources contributing to Turkey Creek water quality problems and making decisions with regards to the types of management that will be recommended to correct in-stream problems. This group was also encouraged to seek funding through existing USDA programs such as the Water Quality Incentive Program for expansion of the demonstration project to encompass the entire Turkey Creek Watershed. The advisory committee was also to be involved in surveys designed to determine landowner attitudes concerning innovative approaches to water quality and stream health protection within this project area.

Watershed Advisory Group Summary:

A ten-member Watershed Advisory Group (WAG) was originally envisioned for the watershed, consisting of ten members from throughout the Turkey Creek Watershed. (Table 9). This group was made up of conservation district employees and board members and influential members of communities in the watershed.

Table 9. Initial Membership of Turkey Creek Watershed Advisory Group.

NAME	AFFILIATION
Matt Gard	Major County CD
Jay Hague	Alfalfa Count CD
Tim Taggart	Kingfisher Count CD
Richard Wuerflein	Garfield County CD
Jean Ann Casey	Hennessey landowner
Eric Wehrenberg	OK Wheatgrowers Assoc
Roger Heneke	Drumond vet/landowner
Dennis Schoenhals	Bank President
Greg Kokojohn	Drummond Public school Vo-Ag
Larry Tripp	NODA

A meeting was scheduled for March 16, 2001 for the watershed advisory group to meet; unfortunately an ice storm the night before canceled the meeting. Difficulties with rescheduling necessitated that OCC and district personnel initiate discussion of the WAG's intended focus via telephone conversations. During these discussions, it became evident that several issues, politics chief among them, were going to prevent the group from a four county area from operating in a manner that would focus on the goals of the project and allow development of an implementation plan.

It also became apparent during these phone calls that there due to the size of the watershed, that a ten member group was not adequate to achieve appropriate representation from the entire watershed. Numerous additional figureheads in the watershed could offer guidance and recommendations and their exclusion from the group would be noted to an extent that might result in lack of local acceptance of the project plan. However, a large Watershed Advisory Group, with twenty or so members, especially given the various local concerns, might not be the best type of group to address the particular needs of this project.

At this point, it was decided that two advisory groups would be utilized for the project. The first, larger group was used to keep districts informed of the project activities and to offer input in a less politically charged environment (over the phone rather than in a public meeting). The entire large group did not meet; rather the conservation district representatives and OCC personnel discussed issues via phone calls and then brought various concerns and ideas back to the core group of OCC and district personnel.

The second group, made up of farmers in the demonstration sub-watershed, would be used to recommend practices and cost-share rates to the Commission. District personnel and OCC staff met with these landowners to discuss problems on their farms, and in the Little Turkey Creek watershed, in general, in order to arrive at solutions. They evaluated both the types of practices and the cost-share rates necessary for them to be able to address water quality issues in the area. This information was combined to develop the Watershed Implementation Plan for Turkey Creek (Appendix F).

The larger WAG was also very influential with the watershed survey designed to determine how landowner attitudes concerning innovative approaches to water quality and stream health protection within the project area. Although the group did not design the survey, they were very instrumental with distributing the survey both by recommending recipients for the survey and delivering the survey to its intended recipients.

Project Activity: Establish Demonstration Watershed (Subwatershed)

Activity Description:

A small subwatershed of Turkey Creek was to be selected as a demonstration site. This watershed would be selected as a result of Tasks III and IV of this project, with the implementation program being determined by the advisory committee. The demonstration project would be a pilot watershed for future projects and a resource for the education programs in the area. The advisory group would tailor this demonstration project to address the problems identified in Task IV. Promotional materials on the demonstration watershed might include farm signs, a pamphlet on protecting water quality and the benefits of management practices installed in the demonstration watershed. Details of this task would be refined as the implementation plan is completed. A portion of the funding for this phase of the project would provided through the FY 1996 grant, along with state funds, with future requests for additional 319(h) funding made on an as needed basis. There was a possibility that no additional funds would be requested.

Demonstration Watershed Summary:

Early watershed reconnaissance suggested a number of high profile sites that could be potential demonstration sites. These included sites in Lower Turkey Creek, Buffalo Creek, Clear Creek, Little Turkey Creek, and Upper and Middle Turkey Creek. Sites were documented where riparian areas were degraded, streambanks were failing, row crops were planted to the stream edge and through intermittent channels, etc. Landowners were identified and contacts were made with local conservation districts, District Conservationists, and other appropriate personnel.

During discussion with local NRCS and Conservation District representatives OCC personnel asked for opinions on water quality issues and potential sources in the watershed as well as potential solutions to the problem. It was evident, early on, that in some cases, there was significant friction between NRCS and Conservation Districts and that this discord extended beyond these two groups to local landowners and producers. Particularly troubling, based on the information we had assimilated about the water quality problems in the watershed and the importance of streambank stabilization, was the lack of interest from most groups in promoting riparian practices.

However, we reviewed possible subwatersheds with our contacts at the Kingfisher County Conservation District, and based on their contacts with landowners, the Little Turkey Creek Watershed (Figures 7 and 8) was chosen as the best site for a demonstration watershed. The small size of the watershed, plus the interest from a large percentage of landowners in the watershed made it a good choice for demonstration. It was also determined that demonstration farms in Alfalfa and Garfield County could be set up to showcase practices in those areas of the Turkey Creek Watershed.

Based on the Rosgen classification and the reconnaissance, the most desirable program would be one that focused on riparian practices. Landowners were contacted and an area of interest was established in the upper portion of the Little Turkey Creek Watershed (Figure 9). Most of the channels affected were intermittent channels where farmers were planting through the channel. The intent was to protect these areas and, at the same time, show farmers it wasn't worth the effort to plow and plant through these channels. By focusing on the upper most portion of the watershed, perhaps significant sources of sediment and other pollutants could be reduced, and the concentration of practices in this area would lend itself towards a water quality monitoring program where success might be well documented.

Unfortunately, not all of the landowners were willing to cooperate and focus only on riparian practices. Almost all of the landowners were interested in additional practices such a pasture sprigging, terracing,etc., and only the landowners on whose farms the creeks had incised significantly to make plowing and planting increasingly difficult were willing to put in riparian areas. Those who could still pull the plow and planter through the channel were unwilling to change that practice.

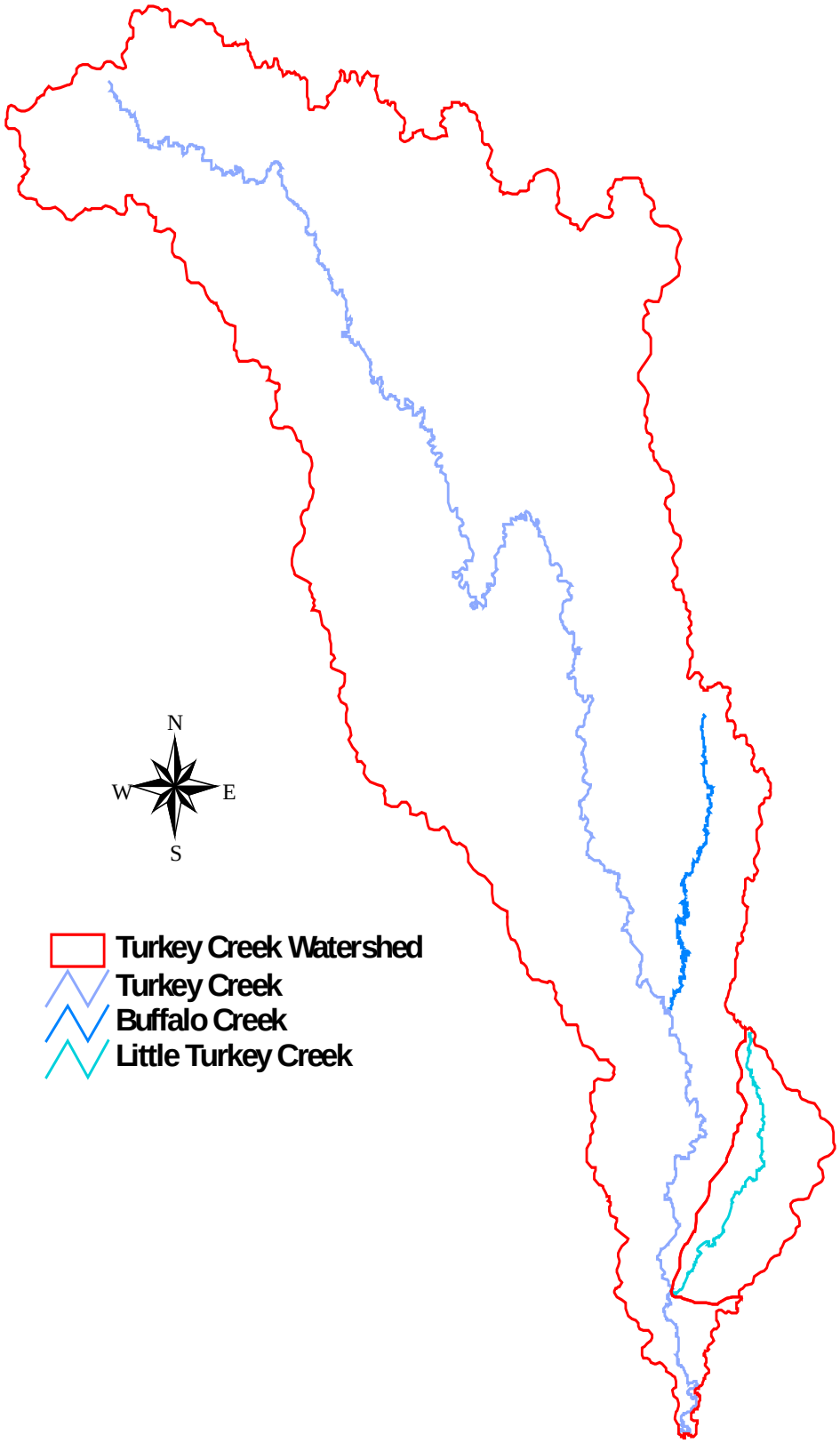

Figure 7. Location of the Little Turkey Creek Watershed

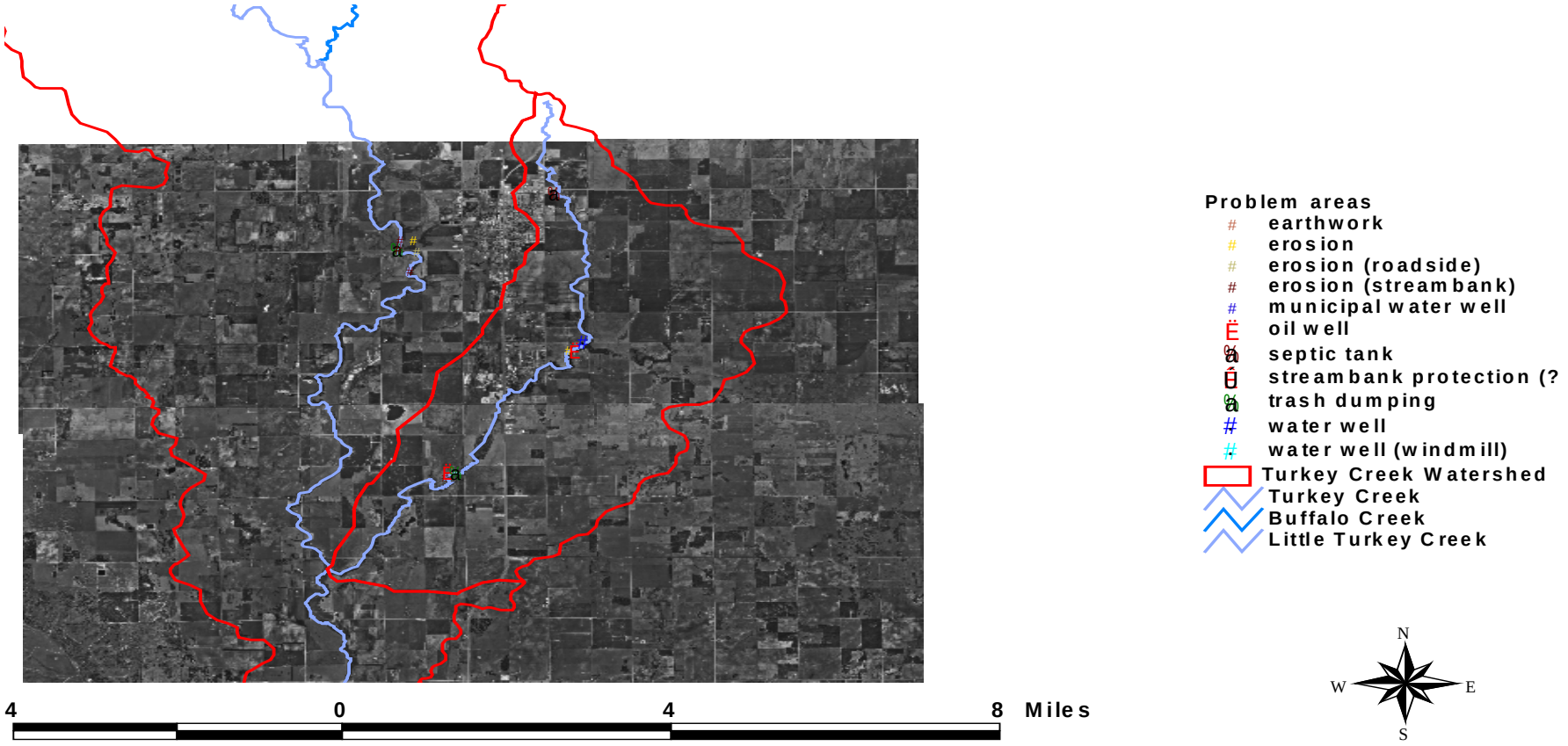

Figure 8. Little Turkey Creek Watershed.

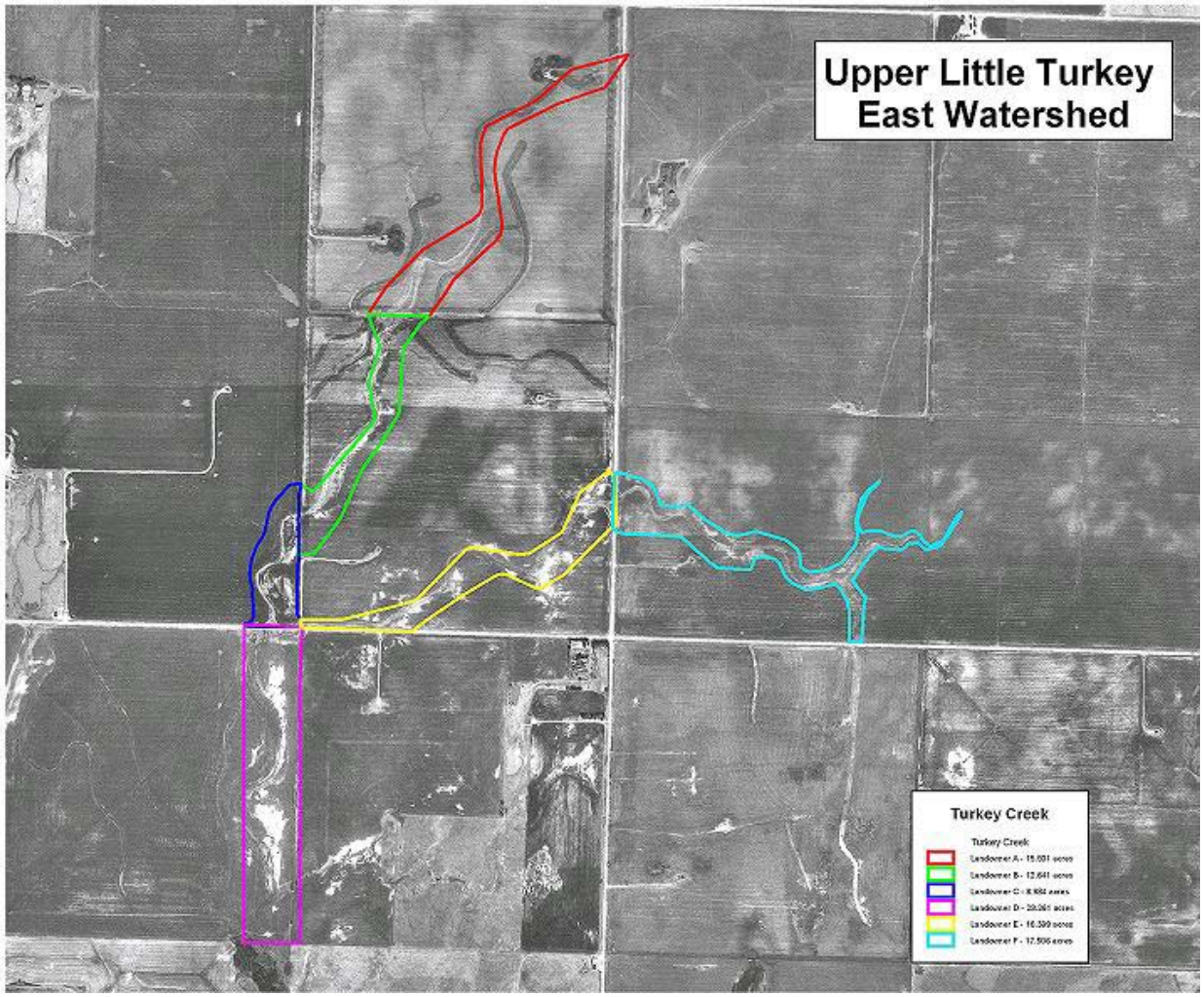

Figure 9. Areas of Interest in the Little Turkey Creek Watershed.

Based on that discussion, it was obvious that an alternative strategy would be necessary, one that would allow for practices other than riparian areas to be included. Otherwise it would be difficult to get the practices concentrated sufficiently in an area to demonstrate water quality improvements. By working throughout the Turkey Creek Watershed, it might have been possible to find enough landowners willing to only implement riparian practices; however, it would be impossible to document water quality improvements due to the size of the watershed and additional sources of impairments.

Following this decision, Steve Winters (Kingfisher County Conservation District) once again contacted the landowners in the watershed to verify whether they would be willing to participate in the program and to get a better idea of their individual conservation needs. In addition, several meetings and phone calls were held with NRCS and FSA representatives in the watershed to facilitate coordination between CRP, EQIP, and the 319 project, where possible. NRCS trained Steve Winters to write farm plans so he would be able to prepare the plans for the program.

Potential plans were drafted for ten landowners in the watershed (Table 10). Most of these landowners were located in the eastern portion of the upper Little Turkey Watershed. The applicants were to be prioritized based on their relative contribution to 1) sediment, 2) bacteria, and 3) nutrient loading.

Table 10. Potential BMPs to be Implemented in Little Turkey Creek.

Landowner #	BMPs	Cost		
		Total	State	319
1	Gully Shaping, pasture planting, field preparation	$2,800	$1,000	$1,800
2	Waterways, grass plantings, bard ditch repair (w/ County Commissioner)			
3	Buffer establishment			
4- lower priority	Oilfield erosion			
5	Cross fencing, water well and tank, rotational grazing, plant legumes			
6	Grass planting	$3,800	$1,000	$2,800
7	Grass planting, grassed waterways			
8	Grassed waterways			
9	Potential WRP project site- old drainage ditch bringing water into Little Turkey Watershed???			
10	Grass planting, buffer establishment			

However, once potential landowners had been identified and potential practices outlined, no further progress was made to implement BMPs. The implementation effort seemed to have high-centered, whether it was because the Conservation District needed more leadership from OCC due to some other factor is debatable. Therefore, the OCC Special Projects Coordinator contacted Steve Winters and the landowners directly to review the initial plans and develop an overall plan for implementation.

The needs identified through this interaction with landowners, along with knowledge of water quality problems in the watershed and a knowledge of effective BMPs, was used to help determine the suite of practices that should be offered through the program. From those recommendations, with approval from the Conservation District Boards, and with modification to certain cost-share rates and approved costs based on local prices, the Watershed Implementation Plan was developed (Appendix F).

Unfortunately, during this negotiation between the Districts and the Commission, Steve Winters left his position at Kingfisher County. In addition, the supplementary funding included in the project for District personnel had been expended so no money was left to continue to supplement stipends to insure cooperation from District staff. The combination of these two factors resulted in very little cooperation from the District personnel. Repeated appearances by OCC staff at District Board meetings to explain and attempt to remedy the situation were met with agreement from the Board that the project continue, but no increased cooperation from District staff.

Without District cooperation, OCC was not able to put the practices on the ground. Although OCC finally was forced to contact landowners and attempt put BMPs on the ground without the District support, we were unsuccessful. By this time, implementation had been discussed with these landowners for at least three to four years. Some landowners had implemented some of the practices on their own without cost-share assistance. Some of the land had changed ownership and the new owners were not interested. Other landowners were no longer interested in bothering with the program without the guarantee of District involvement and support. Perhaps they weren't comfortable interacting with "strangers from the government" as opposed to their local District personnel. There were also some issues related to weather and appropriate planting time that meant that by the time the landowner would be able to plant, they would not be eligible for the full amount of cost-share assistance due to the end of the project period.

Although the implementation effort was not successful, it did offer a score of "lessons learned" that OCC will continue to apply to future efforts. These include:

- If the local Conservation District, the group responsible for promoting land conservation programs at a local level, is not willing to cooperate in a program, it may not be worthwhile to pursue the implementation. Turkey Creek does not drain into high priority waters nor is it a high priority drinking water supply. Most people in the state are more concerned higher profile waterbodies. If the citizens of Turkey Creek truly aren't interested, then, perhaps regardless of degree of impairment, limited remediation funds should be focused where local citizens are more interested in promoting the program. BMPs are prevalent in watersheds adjacent to Turkey Creek, yet notably absent in Turkey

Creek. Opportunity for cost-share and technical assistance[1], land uses, historical problems, etc. are no different in these watersheds than in Turkey Creek. The notable difference appears to be a combination of Conservation District and NRCS cooperation and support which is currently lacking in the Turkey Creek. Watershed.

- Relying on District staff to complete tasks is not always effective. District staff may lack the training and the supervision to complete the effort necessary to implement a project. Placement of water quality staff in district offices to complete the same tasks has proven much more effective. The primary priority of the water quality staff person will always be the project they were hired to complete whereas the primary priority for District Staff person may remain the job they were charged with before (and often in addition to) the water quality project. Any future OCC implementation effort should be pursued by hiring a local project coordinator, to be housed out of a District office, but to be supervised by OCC.
- Repeated delays or too much buildup to a program without actual outputs can lead to apathy from landowners. The well-intended build-up and planning of the program, early on, before the District staff truly had the skills to implement practices and before the watershed had really been evaluated to determine the most appropriate BMPs led to apathy from the landowners about participating. Although some implemented certain practices on their own, most ended up not doing anything. Future implementation efforts should be well planned prior to their introduction to the landowner. Although local buy-in is important, the appearance of structure and organization may be equally important. Future efforts should be introduced to the landowner not more than two months before practices are ready to go on the ground.
- A Journal of contacts, meetings, and phone calls (Appendix H) is an incredibly valuable tool for a project manager to maintain. Changeover of personnel during a project is a very common event. Often the only means of understanding why something did or didn't happen is when events are recorded in some manner. Although the project journal included was not continued following the departure of one of the three project managers that were active during the completion of this project, it does give a glimpse at the amount of work devoted towards the project.
- An important point illustrated by the pre-project survey was that although farmers are concerned about natural resource conservation, they generally can't afford to be concerned about conservation at the expense of productivity. Therefore, unless positive economics related to BMP effectiveness can be demonstrated to them, they will be unlikely to employ that BMP.

Some implementation has occurred in the Turkey Creek Watershed. FSA and NRCS have had limited success with the CRP program in the Turkey Creek Watershed. They've put approximately 225 acres of native grass through the Conservation Reserve Program on two

[1] Actually, opportunities for cost-share assistance may have been greater in the Turkey Creek Watershed than in adjoining watersheds. In addition to the locally-led cost-share program, EQIP, and CRP programs also offered in adjacent watersheds, there was a tremendous push towards the Wetland Reserve Program in the Drummond Flats portion of Turkey Creek, and, of course, the 319 program. In addition, during the course of the 319 program, the Project manger pursued no less than five additional projects, none of which came to fruition due mostly to lack of local interest.

different landowner's properties. In addition, there appears to be renewed interest in the Wetlands Reserve Program in Drummond Flats Area of the Watershed. Farmers who once plowed and planted the wetlands every year only to lose the crop and collect crop insurance are now interested in protecting and re-establishing the wetland. Figures are not yet available on the extent of acreage that may be enrolled.

Measures of Success:

Success of a watershed project can be measured in different ways. One way is to determine whether changes in water quality and beneficial use support have occurred. For this project, the intent was to determine success through an evaluation of pre- and post-monitoring information. Another measure of success can be determined through the adoption and implementation of water quality based management practices.

Because practices were not implemented, post-implementation monitoring did not occur. Also because practices were not implemented, this project was not successful in reducing loading to the watershed.

However, this project did support and lead to several efforts that may eventually result in decreased loadings to the Watershed. These efforts include:

- Data collection critical to development of the TMDL. Landuse, reconnaissance, and water quality data are all being employed in TMDL development. In addition, while working on this project, we cooperated with USGS personnel doing watershed monitoring to insure that the data they collected was complimentary to watershed efforts. In particular, the USGS program will include bacterial source tracking to help determine the primary sources of bacterial contamination in Turkey Creek (human vs. livestock vs. wildlife, etc.)
- OCC work in the watershed, including this project, and a 104(b)(3) wetlands project, actively pursued wetlands rehabilitation of the Drummond Flats area through the FSA/NRCS Wetlands Reserve Program efforts. This was a highly controversial topic and there was significant resistance from local landowners when the subject was first introduced. However, with considerable effort from the NRCS, FSA, Fish and Wildlife Service, OCC, and other partners, the program appears to be gaining a foothold. Restoration of the wetland functions in this area could have profound impacts on water quality in Turkey Creek
- Data collected during this project assured that Turkey Creek remained on the State's Category V List of Impaired Waters and therefore on the State's Priority Watershed List. Because of the verification of continued water quality impairments, a later project will estimate loading contributions from different areas of the watershed and help pinpoint the areas of the watershed where BMPs are most needed. This targeting would allow future implementation efforts to be put on the ground in a focused, timely manner because it will identify the likely primary sources pollution and therefore the types of practices necessary to address those sources.
- Information accumulated, particularly through the Rosgen assessment suggests that simple Riparian zone protection and buffering could have a significant impact on

sediment erosion in the watershed. Therefore, although the impairments to the water resources are not insignificant, they may not be insurmountable.

Therefore, although this project did not directly reduce loading to Turkey Creek, it was an important part of the progress in that direction. In addition, considering that little, if any work had previously been completed in the watershed, it may have been unreasonable to expect that this project could successfully reduce loading in such a large watershed. Most watersheds where successful loading reduction programs have been employed have already been investigated much more than Turkey Creek had been at the onset of this project.

Conclusion:

Turkey Creek is impaired by fecal bacteria and turbidity. Nutrients, low dissolved oxygen, and sediment are also of concern. Rosgen classification suggests that the unprotected streambanks are of significant concern to the stability of the system. Reconnaissance suggests that lack of riparian protection, unrestricted livestock access to streams, cropping near streams and through intermittent channels, overall lack of buffering, and, at times, inappropriate application of fertilizers and pesticides are contributing to the problems.

A pre-project survey of landowners willingness to utilize best management practices suggested that landowners were amenable to BMPs, but that they needed proof of the sound economics of utilizes practices, especially those they were unfamiliar with, before they would be willing to implement them. The survey also suggested that hog farms and flooding were important issues for non-agriculture producers in the watershed while streambank management and waste dumping were important issues for agricultural producers.

A series of events and other factors combined to prevent implementation from occurring as planned. Factor such as inexperience and later, unwillingness of District staff to pursue the implementation efforts; perhaps an inadvertently cultured apathy from landowners who had been introduced to and promised a 1program with a changing focus that never seemed to materialize; a tenuous relationship, in some cases, between NRCS and District personnel; and, in hindsight, insufficient, upfront project planning combined to prevent implementation from occurring.

Certainly mistakes were made in pursuing implementation; however, the overall lack of BMPs in the Turkey Creek Watershed compared to adjoining watersheds with similar problems and fewer funding opportunities suggests that there is more to it than an ineffective effort on OCC's part. Nonetheless, valuable information has been gained through the project that can be applied to similar efforts in other parts of the program and to future efforts to restore Turkey Creek. One of the most important of these is the water quality data that has been generated through this project. This data is the foundation of the TMDL being developed for the Creek. In addition, it has helped new monitoring efforts in the watershed, such as those from USGS, in more informative directions.

Some of the project efforts appear to have helped with attempts to restore wetlands functions to the Drummond Flats area. Certainly this project was not alone in focusing on that issue; however, meetings and discussions by OCC did play a role in assisting with FSA and NRCS efforts to develop a Wetlands Reserve Program for the area.

In addition, information collected through the program suggests that once a mechanism can be discovered to assure local interest in the program and capable delivery of technical support, BMPs could be employed that would reduce sediment, nutrient, and likely fecal bacteria loading to the creek. The likely sources of pollution are the type that have been proven to be reduced by BMPs ranging from nutrient management to riparian and buffer zone establishment.

An effort is now ongoing to complete modeling of sources and quantities of loading to the Turkey Creek watershed using the SWAT model. This information will be utilized in the TMDL, and could also serve as a targeting mechanism for future implementation. Based on the results of this effort, practices and funding necessary to complete implementation could be decided prior to presenting the matter to the landowners. Landowner input into the suite of practices and the cost-share rates necessary for adoption could then be allowed. This pre-planning might help assuage some of the apathy that developed associated with this project. In addition, a completed TMDL might help spur some of the landowners to participate in a voluntary program lest they eventually be forced to implement to address the TMDL goals.

Literature Cited:

Rosgen, D. and L. Silvey. 1998. Field Guide for Stream Classification. Wildland Hydrology. Pagosa Springs, CO.

Appendix A: Pre-Project Survey

TURKEY CREEK EDUCATIONAL ASSESSMENT PROJECT
PHASE I

FINAL REPORT

MAY 1997 – JANUARY 1998

BY

Troy A. Pierce, Agricultural Experiment Station Research Associate
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OKLAHOMA STATE UNIVERSITY

STATE OF OKLAHOMA REPORT
SPONSORED BY THE OKLAHOMA CONSERVATION COMMISSION

INTRODUCTION

The Oklahoma Conservation Commission (OCC) indicated to Oklahoma State University (OSU) that it wanted to conduct water quality educational programming within the Turkey Creek watershed in Western Oklahoma. OCC asked OSU for expertise in determining Turkey Creek watershed residents' input for the proposed educational program. The State Evaluation Specialist and the Experiment Station Research Associate recommended to OCC that a needs assessment be conducted in the Turkey Creek area. This needs assessment was recommended to determine target residents' perceptions of water quality problems and possible solutions to those problems. By including input from local residents prior to water quality educational program development and implementation, it was hoped that residents would be involved at a higher level in the program; would be more content with the program that was developed; and would be satisfied that their needs were also met by the program. OSU also recommended that formative and summative evaluation be conducted for the water quality educational program to provide running input from local residents and to provide accountability of the program. OCC contracted OSU to conduct a needs assessment of residents within the Turkey Creek area concerning the proposed water quality educational program.

METHODOLOGY

After several communications and meetings between the researchers (OSU) and the Oklahoma Conservation Commission (OCC), it was determined that the best way to conduct the needs assessment would be to use a combination of three data gathering methods. The three data gathering methods chosen were a county fair attendee survey, a vocational agriculture parent/neighbor survey, and focus groups of local residents and professionals. The survey methods were chosen as a relatively easy way to collect information from large groups of local residents. The focus group method was used to collect more in depth information from local residents and professionals.

County Fair Attendee Survey

The county fair survey was named the "Turkey Creek County Fair Water Quality Survey 1997". The survey was developed by the State Evaluation Specialist and the Experiment Station Research Associate . The survey was kept simple and included five questions which could be answered quickly by fair attendees as they stopped at the Kingfisher and Garfield Counties' Conservation District booths. The question were all of

the "yes/no" answer type including a question at the end which allowed respondents to describe any additional water quality concerns. The instrument was reviewed by three experts in the area of water quality. The respective conservation district personnel were instructed to ask fair attendees who passed by the conservation district booths to fill out the survey. Forty-four usable surveys were collected from the Kingfisher and Garfield county fairs combined. There were 16 surveys from the Kingfisher County Fair and 26 surveys from the Garfield County Fair. The Experiment Station Research Associate went to the Garfield County Fair and trained the Conservation District person on the technique for conducting the survey. The technique was to greet a fair attendee and ask them if they would take a couple of minutes and fill out a short survey to help protect their water quality. Then, the Conservation District person would ask each question and record the respondents' answer. At the end of the survey, the respondent would be thanked and welcomed to look over the information presented at the Conservation District booth. During the one-hour the Research Associate was at the fair 20 surveys were filled out. These 44 respondents will be considered as a purposive sample of adult fair attendees for this study. The surveys from Kingfisher County and Garfield County fairs were combined as no significant difference at the alpha 0.05 level was found between responses from the two fairs. The Excel spreadsheet program was used for data analysis.

Vocational Agriculture Parent/Neighbor Survey

For the vocational agriculture parent/neighbor survey, the name "Turkey Creek Area Water Quality Survey" was given. The instrument was developed by the State Evaluation Specialist and the Experiment Station Research Associate. Three experts in water quality and two experts in agricultural education reviewed the survey instrument. There were a total of 22 questions on the instrument. Five Likert type questions were included. The other question types were "yes/no", fill in the blank or circle the answer. Three "yes/no" questions also asked the respondents to describe their "yes" responses. The Kingfisher County NRCS office distributed the instrument to the respective vocational agriculture teachers to distribute to their local FFA chapter members. These FFA members (members have to be students in the 7th through 12th grades) took the surveys home to their parents to fill out. Once the parents filled out the surveys, the students brought them back to their vocational agriculture teacher. The students also gave the survey to one of their adult neighbors, who did not have school age children, to fill out. The students also brought back these neighbor surveys to their vocational agriculture teacher. The OSU survey distribution methodology called for the surveys to be separated based on school and parent or neighbor survey. When OSU received the completed surveys back from the Kingfisher County Conservation District, the surveys had been mixed together and could not be analyzed based on specific school or for differences in parent versus neighbor responses. Since the initial methodology was no longer possible, the surveys could only be separated by whether a respondent was an agricultural producer or not. Eight FFA chapters within Turkey Creek watershed were given the survey to distribute during October-December of 1997. Six of the FFA chapters returned their surveys by January 1, 1998 for a total of 237 usable surveys. These 237 respondents were considered a purposive sample of the population of adults

within the Turkey Creek watershed. The chapters that returned the survey by the due date included: Chisholm, Cimmaron, Dover, Drummond, Hennessey, and Waukomis. These six FFA chapters provided excellent area coverage of the watershed.

The Excel spreadsheet program was used for the analysis of quantitative data from the survey instrument. An alpha level of 0.05 was chosen to determine statistical significance.

Focus Groups

In addition to the surveys, six focus groups and one long interview were conducted. The focus groups and long interview techniques were used to provide data which would describe in greater detail the needs and perceived water quality problems and solutions as described by local resident and professional groups. The six focus groups included the following: League of Women Voters; high school students; agricultural producers; Conservation District Board members; Cooperative Extension Service personnel; and NRCS personnel. The long interview technique was used to gather data from a member of a local wildlife conservation chapter. The focus groups and the long interview lasted for approximately one hour per session. Three key questions were developed for the focus groups and are as follows: 1) What water quality concerns are you aware of involving surface water, ground water and/or drinking water?; 2) What sources of pollution are you aware of involving surface, ground and/or drinking water?; and, 3) What are solutions to pollution problems that you are aware of involving surface, ground and/or drinking water? These same questions were used as grand questions for the long interview. Note-Based Analysis was used to determine trends in the focus group data.

RESULTS

County Fair Attendee Survey

As mentioned earlier on the analysis of the "Turkey Creek County Fair Water Quality Survey 1997", there was no significant difference between responses from the two fairs so the surveys were combined. The results of the county fair survey are shown in Table I. Most respondents (54.5 percent) did live in the Turkey Creek area. Also, a majority of the respondents were concerned about their area water quality (93.2 percent); said they would attend water quality educational programs (77.3 percent); and would at least "maybe" be willing to change their practices to protect water quality (95.5 percent). Three-fourths of the respondents said that they did have a water quality concern at the time of completing the survey. Of those who said they did have a concern, one-third said that their concern was "hog farms". "Flooding" and "salt water" were the next two highest concerns of respondents and each accounted for nearly 10 percent of expressed concern.

TABLE I. COUNTY FAIR ATTENDEE SURVEY RESULTS

Question	# of respondents
Do you live in the Turkey Creek area?	
yes	24
no	13
don't know	7
Are you concerned about water quality in your area?	
yes	41
no	3
Would you attend water quality educational programs?	
yes	34
no	9
Would you be willing to change your practices to protect water quality?	
yes	32
maybe	10
no	2
Do you have any water quality concerns at this time?	
yes	33
no	11
If yes (have concerns), what are they?	
hog farms	11
flooding	3
salt water	3
chemicals	2
Lone Mountain	2
not enough good water	2
smells bad	2
tastes bad	2
arsenic, bacteria, dirty water, erosion, hard water, local sewer, nitrate, pesticides, runoff, sediment or silt	1

Vocational Agriculture Parent/Neighbor Survey

There were several significant differences found in responses between agricultural producers and non-producers on the vocational agriculture parent/neighbor survey. Responses which showed significant differences between producers and non-producers are presented in Table II. There were 69 respondents who identified that they did have a farm or ranch and, therefore, were considered agricultural producers for this study. The

remaining respondents were considered non-agricultural producers for this study. Agricultural producers reported living in the area more than twice as long as non-producers. Non-producers agreed less strongly as compared to agricultural producers that farm operator's use of Best Management Practices (BMPs) was the best way to control water pollution in the area. Producers agreed more strongly than non-producers that livestock should have free access to streams. Overwhelmingly, agricultural producers disagreed that windbreaks/shelter belts were needed in their area to decrease wind erosion. However, most non-producers agreed that windbreaks/shelter belts were needed. A larger percentage of non-producers thought that the fishing in Turkey Creek had gotten worse since they had lived in the area as compared to agricultural producers.

TABLE II. SIGNIFICANT MEAN DIFFERENCES: AGRICULTURAL PRODUCERS VS. NON-PRODUCERS

Question	Ag Producers	Non-producers	Probability
How long have you lived in the area? (years)	33.5	15.7	2.26E-13
Water pollution in your area can best be controlled through farm operator's use of Best Management Practices. (Strongly Agree=1; Agree=2; Neutral=3; Disagree=4; Strongly Disagree=5)	2.05	2.29	0.024
Should livestock have free access to streams? (yes=1; no=2)	1.21	1.36	0.020
Are windbreaks/shelter belts needed in your area to decrease wind erosion? (yes=1; no=2)	1.75	1.36	1.60E-08
Over the time you have lived here, has the fishing in Turkey Creek: (Improved=1; Remained the Same=2; Gotten Worse=3)	2	2.22	0.011

Table III reports the results of questions that showed no significant difference in average response between agricultural producers and non-producers. On the average, respondents indicated that they would be willing to adopt practices that provided the best water quality in their area. The respondents also indicated that on the average they were concerned about the quality of their drinking water. Respondent who had specific concerns about their drinking water had the following concerns: 21 respondents were concerned about nitrate; 19 were concerned with hog farms; 11 had hard water concerns; 10 reported bad tasting water; 7 had concerns over dirty water; 6, respectively, had concerns about chemicals, oil wells or the smell of their drinking water; 3, respectively,

had concerns about bacteria or water color; 2, respectively, had concerns about diseases, farming, fertilizers, pesticides, or salt water wells, and, 1 had concerns about heavy metals and another had concerns with landfills. The mean response indicated that respondents felt that their current area water quality was about the same as it was 5 years ago. Overall, the respondents agreed that farmers should use practices that protect water quality whenever feasible. More respondents reported that streambank erosion was not a problem in their area as compared to those that thought it was a problem. Those respondents who reported that streambank erosion was an area problem said they thought the following were the causes of that erosion: 28 said flooding; 8 said farming; 4, respectively, said erosion, lack of vegetation, or weather; 2, respectively, said debris, oil wells, tree removal, or runoff; and, finally, 1, respectively, said beavers, cattle, creek curves, no control, steep banks or trees were the cause. There seemed to be an even distribution between respondents concerning whether or not the depth or width of Turkey Creek had changed since they have lived in the area. About half said "yes" and about half said "no" concerning these Turkey Creek changes. Those respondents who thought the depth or width of Turkey Creek had changed described the following changes: 40 respondents said the Creek was wider; 16 indicated flooding caused changes; 11 believed the Creek was deeper; 8 respondents said the Creek was more shallow; 4 responded that the banks had moved; 2 people each thought that their were curve changes or tributary changes; and, 1 respondent each though either sediment, silt or trash caused changes in the depth or width of Turkey Creek.

TABLE III. SIMILAR MEAN RESPONSES: AGRICULTRUAL PRODUCERS AND NONPRODUCERS

Question	Ag Producers	Non-producers	Probability
Would you be willing to adopt practices that provide the best water quality in your area? (yes=1; no=2)	1.07	1.11	0.452
Compared to five years ago, do you think water quality in your area is: (Better=1; About the Same=2; Worse=3)	2.27	2.30	0.692
Farmers should use practices that protect water quality whenever feasible. (Strongly Agree=1; Agree=2; Neutral=3; Disagree=4; Strongly Disagree=5)	1.71	1.71	0.987

TABLE III. CONTINUED

Question	Ag Producers	Non-producers	Probability
Is streambank erosion a problem in your area? (yes=1; no=2; specific causes described in text)	1.69	1.68	0.956
Over the time you have lived here, has the depth or width of Turkey Creek changed? (yes=1; no=2; specific changes described in text)	1.48	1.58	0.167
Over the time you have lived here, has the amount of algae and/or moss in Turkey Creek: (Increased=1; Remained the Same=2; Gotten Worse=3)	1.84	1.89	0.524
Are you concerned about the quality of your drinking water? (yes=1; no=2; specific concerns described in text)	1.27	1.25	0.782

The agricultural producers had an average of 811.5 acres of farm/ranch land with a reported range of 1 to 3,500 acres. These producers had been farming/ranching on the average 24.5 years with a range of 2 to 65 years experience. Of the 69 agricultural producers, 49 reported raising wheat and cattle in combination, when asked whether they produced cattle or wheat. There were an additional 5 wheat producers who did not raise cattle and an additional 8 cattle producers who did not produce wheat. Soil was tested on the average every 3 years among these producers. More specifically, 11 producers said they had their soil tested every year; 9 producers said every two years; 14 producers said every three years; 21 producers said it was over three years since they had their soil tested; 10 producers said they never had their soil tested; and 4 producers did not respond.

Agricultural producers described how they determined when to apply pesticides, which pesticides to apply and how much fertilizer they applied in Table IV. Producers were able to list multiple answers as these were fill-in-the-blank questions.

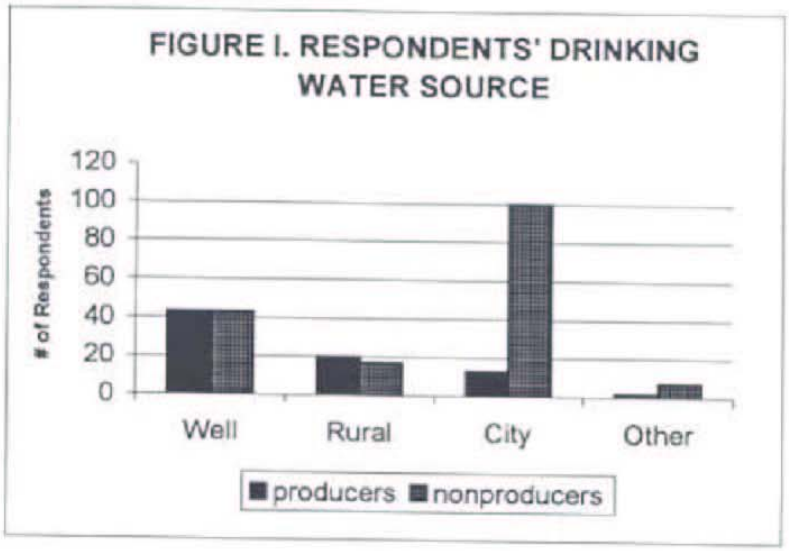
TABLE IV. PRODUCERS' PESTICIDE AND FERTILIZER PRACTICES

Question	Number of Respondents
--How do you determine when to apply pesticides?	
Crop damage	14
Pest present	11
Visual inspection	9
When needed	8
Pest number	4
COOP	3
Extension Agent, Professional, or When neighbors spray	2*
Don't know, Don't use, Experience, Regular intervals, or Seasonal	1*
No response	9
-- How do you determine which pesticides to apply?	
Pest type	15
COOP	14
Applicator	10
Dealer	7
Extension Agent	5
What works	5
Cost, Experience, Label, Pest number, Professional, or Time of year	2*
Don't know, Don't use, Experts, or Temperature	1*
No response	8
--How do you determine how much fertilizer to apply?	
Soil test	33
Experience	8
Amount needed	5
Production level	5
Cost	4
Crop type, Extension Agent/OSU, or Growth	3*
COOP, Dealer, Set amount, or Weather	2*
Color, Don't know, Grandfather, Guess, Label, or Grazing cattle number	1*
No response	9

*Number of respondents giving each indicated response

Respondents were asked to indicate the source of their drinking water; the results can be seen in Figure I. Respondents could list multiple sources. Most, forty-three (62.3 percent), agricultural producers used private wells as their drinking water, but most, one hundred (59.5 percent), non-agricultural producers used city water as their drinking water

source. Of the two agricultural producers who reported using "other" sources, one reported using bottled water. Of the non-producers who reported using "other" sources, four reported using bottled water and two reported using filtered water.



Focus Groups

As mentioned in the Methodology of this report, three key questions were developed to be answered by the focus group participants and the long interviewee. The results of these focus groups and long interview are broken down based on these three key questions: 1) What water quality concerns are you aware of involving surface water, ground water and/or drinking water?; 2) What sources of pollution are you aware of involving surface, ground and/or drinking water?; and, 3) What are solutions to pollution problems that you are aware of involving surface, ground and/or drinking water?

QUESTIONS I & II. **1) What water quality concerns are you aware of involving surface water, groundwater and/or drinking water? and 2) What sources of pollution are you aware of involving surface, ground and/or drinking water?**

All groups immediately began mentioning the sources and types of pollutants that concerned them or their neighbors. So, Questions I and II really ended up providing the same answers. Question I was developed to give focus groups a way to start talking about any concerns that might come to mind about water quality not necessarily just pollution concerns. Water quality pollution concerns tended to dominate their conception

of "water quality" and these pollution concerns really lead into the second question. They readily identified types of pollutants that can be directly related to agriculture (nitrate, sediment, agricultural chemicals, silt etc.) and at the same time identified pollutants associated with industry and urbanization (salt wells, oil fields, Lone Mountain, lawn runoff, etc.). Participants who were directly involved in agriculture did not initially describe agriculture as being a water quality concern. The subject of agriculture pollution was usually broached by a member of the group and not elaborated much by other members of the group or quickly combined with other sources of that pollution. There were varied opinions on what caused major flooding problems in the Turkey Creek area, but the seeming increase in recent years of flooding was definitely the number one problem on the participants' minds.

Worry over potential problems with corporate hog farms also was strong among participants from all groups. Participants seemed to be worried about potential pollution sources when they did not have knowledge of a facilities' process and background (i.e. hazardous waste sites, Air Force Base, nitrogen manufacturing plant etc.) There was also a tendency among participants to clarify their responses with comments such as "now we don't really have this problem in our area, but over east of town....".

The agricultural producer group believed tress growing on the streambank were actually a problem with the creek. They thought that trees should be removed from the immediate creek bank, so that when the streambank eroded, the trees did not fall into the stream and cause blockage and more flooding. Producers also appeared to think that straightening channels of the creek was preferable to having the curves and bends in the creek on their property. The producers also indicated that the fishing is not as good as when they were kids in Turkey Creek and agreed that the algae has increased. Returning streambanks to pasture also had some support among the agricultural producers. Producers seemed willing to adopt new practices as long as it was economically in their best interest and protected their land.

Typical comments on the subject of agricultural impacts:

"Back to his statement on nitrates, on farmers causing it, you know that the people in the city are putting fertilizer on their grass; farmers don't have that kind of money." (Conservation District Directors' Group)

"I am not to sure how much our fertilizers affect our runoff waters. The main thing we are concerned with is the spraying of weeds...loss of habitat. They are spraying right up in the fence rows, anymore. Their wheat fields look manicured and that does not make for good habitat." (Wildlife Conservation Interview)

"Having livestock going down there (Turkey Creek) and having free access to it. When they get in there they make waste into the creek." (Youth Group)

"The excess nitrates that are showing up in the water are from some type of human activity. Um, I am not trying to point a finger at agriculture because they're usually fairly

conservative with what they apply to their fields, but I do think that part of it is runoff from freshly turned over fields." (League of Women Voters' Group)

"Sheet erosion, there were fields last summer washed clear down to the hardpan. Every bit of topsoil was taken off of them. I'm not talking about small patches either; we're talking about 60-acre fields just dumped." (Agricultural Producers' Group)

Typical comments on the subject of flooding:

"My wife remembers where the creek (Turkey Creek) makes a turn there and there is a big cliff, she says that when she was a girl she can remember how they used to drive between that one pole and the creek, but the creek is up to the pole now." (Agricultural Producers' Group)

"If it rains 2 or 3 inches, Turkey Creek floods. People don't keep the creek cleaned out of old dead trees and stuff. Last time it flooded, sewage from Lahoma overflowed into Turkey Creek and the Creek turned purple. Lagoons run over at dairies." (Youth Group)

"When I was a kid it was a really, really big deal to see water in the flats. We would drive over and watch it. Now, it doesn't take anything and it (Drummond Flats) fills right up." (Agricultural Producers' Group)

"Of course down here in the Drummond Flats area, with the way water stands down there and floods, anything that is down in there is going to go right into the water and the creek." (League of Women Voters' Group)

"I've had my cows on Charles' place many times just to keep calves from drowning and stuff." (Agricultural Producers' Group)

Typical comments on the subject of corporate hog farms:

"I am just concerned about their operation. I know as many hogs as they run through there and stuff, I don't see how in the world they can keep anything from leaking out." (Agricultural Producers' Group)

"People are really getting alarmed about the large corporate farms, the waste lagoons, about how they are not being regulated. Grandfathering some of these under regulations is bothering everyone." (League of Women Voters' Group)

"We do have some concerns with confined animal feeding operations, mainly pigs and cattle, although those have been addressed to some extent, they still can provide some problems with water quality." (NRCS Personnel Group)

"I have a 6,000 head hog operation a mile from my house. The man who built it is suing the bulldozer company because he says his lagoon is not built right. Smell is just awful." (Extension Personnel Group)

"Hog operations, and things like that, need to be very quality controlled without looking at the dollar they're bringing into the community. It is all political to me, pig operations." (Agricultural Producers' Group)

Typical comments on the subject of household water:

"The water at our house is all salt water, so we drink bottled water." (Youth Group)

"I notice a lot of young people do not drink city (Enid) water. My son, that comes to my house, brings his own water." (League of Women Voters' Group)

"I don't think we're going to have good drinking water someday." (Agricultural Producers' Group)

"Hard water is a problem and it stains your clothes." (Youth Group)

"We have two or three wells just within an 11 acre area and all three wells are different. When the creek floods, one of our wells gets real silty." (Agricultural Producers' Group)

QUESTION III. **What are solutions to pollution problems you are aware of involving surface, ground and/or drinking water?**

Participants basically felt that educating adults was often a lost cause, but at the same time they struggled to think of some way to educate adults. They overwhelmingly suggested concentrating on youth education. The participants felt youth education was the real way to make changes occur within a community concerning water quality issues. There was also a feeling that having educational programs that involved youth with their parents would be effective. The adults thought that youth education is successful at encouraging adults to make changes in their practices. Project WET and the Groundwater Model were mentioned as successful delivery methods. It was also suggested by some that programs be conducted as parts of normal meetings of COOPs, Farm Bureau, civic groups, and other local meetings rather than schedule specific meetings for water quality. Water quality has to be incorporated into meetings that are already interesting to adults, especially economic and business meetings.

There also seems to be support for educational programs targeted at recycling. Many participants were worried about illegal dumping and improper disposal at landfills. These participants thought recycling education and waste disposal site convenience could

help. Landowners felt that those who illegally dumped on the landowner's property did not have respect for rural landowners. Several in the groups complained that regulations were not enforced on environmental pollution problems in the area (mainly waste dumps and construction sites).

Typical comments about educating youth:

"I think it is exciting for the students to go out and actually see, pinpoint, where there are problems and see that something is done about it. If there could be that kind of opportunity for the high school students...that would be something we would like to work out." (League of Women Voters' Group)

(q. How do we get adult support for educational programs?) "From the kids, or just skip a generation, you got to start somewhere. We talked about that in our last meeting, about the education part, going through the FFA and 4-H." (Conservation District Directors' Group)

"We have kids camps now once a year (on conservation). But we are only turning out 30 kids each time and that's just not going to touch it." (Wildlife Conservation Interview)

"Partnership based, that really gives students an avenue to influence a change in their community. Partnerships with state and federal agencies, because they are the ones that can actually provide the muscle and the money that can help these programs along. Schools can't do them on their own any more, because the equipment and training is not in their scope." (League of Women Voters' Group)

"I know what causes me to stop and think is when my grandson looks up at me and points out that I shouldn't be doing something. I mean, I know better, but I do it anyway. It takes young folks to remind us and we feel guilty and won't do it again." (Agricultural Producers' Group)

"Come and have demonstrations or presentations in the gymnasium for the whole school. Also, conduct experiments, hands-on and one-on-one attention." (Youth Group)

Typical comments about waste disposal problems:

"We don't really have a place to take things. If I want to get rid of some old oil, I don't know what to do with it. I hang on to it for awhile, but other people aren't going to do that; they will just put it in the trash." (Extension Personnel Group)

"There are a lot of leaky septic tanks all over these rural areas around here." (League of Women Voters' Group)

"There would be a lot of value to that organic material (grass clipping and leaves) if it was kept clean. We could go out into some of these alkaline areas and some of these pastures and sand hills and add this organic material back. But, nobody wants to bother to sort anything." (Agricultural Producers' Group)

"There are a lot of trash dumps along the way (Turkey Creek). Tires and house trash. There have been signs put up, but you never see a single person go down and watch for people to dump." (Youth Group)

"I think that outside waste being brought into the state, you know, being brought through Enid. There hasn't been a spill yet, but I think it is just a matter of time." (League of Women Voters' Group)

CONCLUSIONS AND RECOMMENDATIONS

It appeared in the fair survey that adults would be willing to attend water quality educational meetings, but during the focus groups, the opposite seemed to be true. The nature of a "yes/no" question on a survey forces a response from a respondent with no room for elaboration. Since the number of county fair surveys completed was very low, it would seem appropriate to place more emphasis on the areas corroborated by multiple focus groups and the much larger scale vocational agriculture parent/neighbor survey rather than on the fair survey. So, the fair survey will be given little emphasis for conclusions and recommendations.

Agricultural producers have lived in the Turkey Creek area much longer than their non-producer neighbors. These producers should then have more knowledge and history of the area as compared to non-producers. Farmers and ranchers, then, are a valuable resource base and should be included in program development that affects them and the surrounding area.

People are willing to adopt new practices to protect their water quality; however, agricultural producers want economic information about adoption of new practices for consideration. If economic benefits cannot be tied to Best Management Practices, especially to BMPs that are perceived as unwanted by producers, there will be little adoption of those new practices. Farmers/ranchers and non-producers do both believe that that agricultural producers should adopt BMPs when feasible and that adoption of those BMPs will improve water quality.

There are conflicting results among area residents concerning any changes which may have occurred in Turkey Creek over the years. Survey results seemed to indicate a fairly equal spread among those who thought physical changes had occurred in the creek and those who had not. However, in focus groups, it seemed overwhelmingly that residents thought Turkey Creek had changed drastically over the last few years. It seems in this case that the dynamics of group interaction may have helped people remember

collectively the changes that have occurred over time. There is, then, a perception that the creek has changed over time in its width, depth and quality. Residents feel that Turkey Creek has degraded significantly during the time they have been in the area.

Some residents did have perceived problems with their drinking water. Tying water quality educational programs to drinking water problems could be a possible option to attract adults. For example, in the Enid and Drummond areas, Oklahom*A*Syst could conduct free water testing and during the same program water quality educational information could be presented. Since most agricultural producers seem to also have water wells, many producers would be interested in a water-testing program.

Agricultural producers use a variety of techniques to determine when and what pesticides to use on their land. Most commonly, though, the choices are directly related to the pest itself or to advice from a private or public professional. Integrated Pest Management strategies do not seem to be employed in this area or producers do not know to report the use of these strategies. Educational programs targeted at pesticide use and choice should involve the local COOPs and dealers, preferably at normal meeting times for these entities.

There seems to be wide spread use of soil testing among agricultural producers, but at varied testing intervals. Long-term free soil testing by NRCS and Cooperative Extension could help put many producers on regular soil testing intervals. Since there does seem to be a nitrate problem in the groundwater in certain areas of the watershed, regular soil testing and aid in following recommendations could be beneficial to many in the Turkey Creek watershed.

Agricultural producers in the area do seem to believe in the value of Best Management Practices. However, certain suggested BMPs do not seem to have wide support among producers. Windbreaks/shelter belts do not seem to be a popular idea among producers. Producers also feel that livestock should have free access to streams. Since there are reported problems with salt intrusion to wells in the area, streams/creeks may be seen as one of few alternatives for watering livestock. Also, some producers feel that converting farmland along creeks back to pasture is better for the local creeks than crop farming on the streambank edge. Streambank management should receive strong emphasis, especially in the Drummond area.

Any education program targeted at farmers/ranchers must remain mindful of how these producers see themselves concerning water pollution. Producers know that they do impact water quality in some ways, but want to be included as one possible source and not "the" source of area water quality problems. The educational effort should target multiple possible pollution sources and be very public that it is seeking to help and educate a varied population that impacts water quality.

Adults in the Turkey Creek watershed feel that the way to educate adults is through and with children. It is recommended that a significant portion of the educational projects in the Turkey Creek area have activities that will involve parents with their children. Many subjects of interest to the local community as well as subjects of interest to governmental agencies should be incorporated into each educational endeavor. Programs, of course, should be hands-on experiences and should have definite outcomes at the end of the programs. Projects and schools in the area which already involve youth in activities of interest to this project are the Meadow Lake Watershed Protection Program (Enid High School), Leonardo's Science Discovery Center, CORPS

of Engineers trail development, and the AURORA Project (Terry Sackett and Enid High School). These projects along with FFA and 4-H would be initial places to start for development of educational programs which involve youth with their parents and other adults. Water quality education targeted specifically at youth should try and incorporate real experiments and real data that can be reported back to interested agencies. By involving youth in programs that collect real data, it is hoped that youth will better understand how people affect the environment and how important individuals can be in protection of that environment.

Finally, any water quality educational programs in the Turkey Creek area will have to address up-front the topics of flooding and hog farms to gain acceptance within the community. With agricultural producers, specifically, illegal waste dumping and streambank management will have to be addressed. These are the needs felt by the local community and must be met by any educational program that addresses water quality because these topics are "water quality" to the local residents.

Appendix B: Water Quality Data

SITE	WBID#	DATE	CONDITION	Field DO mg/l	Field pH S.U.	Field Turb NTU	Chloride mg/l	Sulfate mg/l	TDS mg/l	TSS mg/l	Total Phos mg/l	Total Ortho P mg/l	Nitrate (N) mg/l	Nitrite (N) mg/l	TKN (N) mg/l	Total (N)
Turkey Creek (lower)	OK620910-06-0010B	11/04/97	Base flow	10.83	8.36	9.45	205	122	1016.4	12.5	0.22	0.182	3.8	0.015	0.49	4.305
Turkey Creek (lower)	OK620910-06-0010B	12/02/97	Base flow	10.54	8.27	5.8	220	119	1007.16	9.5	0.155	0.117	2.3	0.024	0.63	2.954
Turkey Creek (lower)	OK620910-06-0010B	01/13/98	Base flow	12.95	8.23	59.5	183	131	1138.5	59	0.29	0.18	3.04	0.018	0.77	3.828
Turkey Creek (lower)	OK620910-06-0010B	02/10/98	Base flow	11.8	8.19	35.4	208	120	1142.46	45.5	0.23	0.154	3.94	0.034	0.663	4.637
Turkey Creek (lower)	OK620910-06-0010B	04/14/98	Base flow	8.69	8.16	37.2	186	110	966.24	52	0.238	0.137	2.62	0.012	0.61	3.242
Turkey Creek (lower)	OK620910-06-0010B	05/19/98	Base flow	7.14	8.08	115	120	68.5	603.24	140	0.449	0.247	1.82	0.028	1.27	3.118
Turkey Creek (lower)	OK620910-06-0010B	06/16/98	Base flow	9.51	8.27	68	225	126	792	88	0.144	0.001	0.733	0.007	1.78	2.52
Turkey Creek (lower)	OK620910-06-0010B	07/22/98	Base flow	4.6	8.15	44.5	246	120	1061.28	58	0.256	0.107	1.14	0.032	0.79	1.962
Turkey Creek (lower)	OK620910-06-0010B	08/18/98	Base flow	3.98	8.18	78.9	182	93.9	892.32	101	0.46	0.267	2.26	0.08	1.28	3.62
Turkey Creek (lower)	OK620910-06-0010B	09/30/98	Base flow	5.8	7.81	135	119	71.6	643.5	109	0.45	0.28	1.63	0.03	1.32	2.98
Turkey Creek (lower)	OK620910-06-0010B	10/27/98	Base flow	8.82		83.8	136	99.2	727.32	70	0.392	0.271	1.68	0.009	0.55	2.239
Turkey Creek (lower)	OK620910-06-0010B	03/17/98	Runoff	10.33	7.68	868	16	2		2145	1.1	0.18	0.748	0.016	3.82	
Turkey Creek (lower)	OK620910-06-0010B	09/22/98	High flow	4.7		1050										
Turkey Creek (Middle)	OK620910-06-0010M	11/04/97	Base flow	11.11	8.47	5.95	265	125	1135.2	7.5	0.18	0.151	3.7	0.012	0.39	4.102
Turkey Creek (Middle)	OK620910-06-0010M	12/02/97	Base flow	10.5	8.27	6.83	225	117	1004.52	7	0.146	0.11	2.5	0.022	0.43	2.952
Turkey Creek (middle)	OK620910-06-0010M	01/13/98	Base flow	12.84	8.14	36.6	225	135	1366.2	39.8	0.23	0.159	3.02	0.013	0.56	3.593
Turkey Creek (middle)	OK620910-06-0010M	02/10/98	Base flow	12.28	8.23	23.9	235	121	1224.96	34	0.193	0.132	3.92	0.023	0.532	4.475
Turkey Creek (middle)	OK620910-06-0010M	04/14/98	Base flow	9.58	8.21	29.3	209	110	1031.58	42.7	0.215	0.128	2.72	0.012	0.72	3.452
Turkey Creek (Middle)	OK620910-06-0010M	05/19/98	Base flow	7.73	8.19	73.5	155	86.9	683.1	117	0.4	0.252	2.13	0.024	1.12	3.274
Turkey Creek (Middle)	OK620910-06-0010M	06/16/98	Base flow	11.12	8.5	16.5	290	133	1089	34	0.236	0.133	1.94	0.019	0.6	2.559
Turkey Creek (Middle)	OK620910-06-0010M	07/22/98	Base flow	9.89	8.5	4.42	345	140	1156.32	7.5	0.279	0.222	0.926	0.005	0.49	1.421
Turkey Creek (middle)	OK620910-06-0010M	08/18/98	Base flow	8.25	8.18	18.5	248	126	1115.4	24.5	0.78	0.442	2.21	0.06	0.86	3.13
Turkey Creek (middle)	OK620910-06-0010M	09/30/98	Base flow	7.44	7.96	41.4	170	99.7	859.32	49.7	0.41	0.4	1.39	0.02	0.87	2.28
Turkey Creek (middle)	OK620910-06-0010M	10/27/98	Base flow	9.36		54	168	109	881.76	46.7	0.334	0.248	1.89	0.008	0.61	2.508
Turkey Creek (middle)	OK620910-06-0010M	03/17/98	Runoff	12.15	7.52	854	13	2		754	0.72	0.2	0.687	0.015	3.13	
Turkey Creek (Middle)	OK620910-06-0010M	07/08/98	Runoff	5.8	7.75	1666	105	59.5		1208	1.804	0.24	1.9	0.049	4.42	
Turkey Creek (Upper)	OK620910-06-0010U	11/04/97	Base flow	11.58	8.06	8.85	230	94	1037.52	11.5	0.2	0.155	3	0.015	0.47	3.485

Turkey Creek (upper)	OK620910-06-0010U	01/13/98	Base flow	12.5	8.19	16.1	180	101	1173.48	17.8	0.21	0.16	2.61	0.009	0.74	3.359
Turkey Creek (upper)	OK620910-06-0010U	02/10/98	Base flow	12.27	8.03	15.3	190	94	1113.42	19.8	0.182	0.116	3.14	0.031	0.635	3.806
Turkey Creek (upper)	OK620910-06-0010U	04/14/98	Base flow	9.55	7.97	27.6	190	97.9	1003.2	42.5	0.235	0.146	2.17	0.032	0.73	2.932
Turkey Creek (upper)	OK620910-06-0010U	05/19/98	Base flow	6.32	7.81	10.3	125	64.5	710.82	133	0.459	0.248	1.84	0.108	1.38	3.328
Turkey Creek (upper)	OK620910-06-0010U	06/16/98	Base flow	10.3	8.17	46.2	244	82.6	891	56	0.45	0.316	1.89	0.05	0.9	2.84
Turkey Creek (upper)	OK620910-06-0010U	07/22/98	Base flow	9.22	8.36	35.8	211	102	1044.12	47.5	0.502	0.432	1.69	0.111	0.92	2.721
Turkey Creek (upper)	OK620910-06-0010U	08/18/98	Base flow	6.09	7.73	174	110	81	697.62	168	0.76	0.467	2.24	0.3	2.17	4.71
Turkey Creek (upper)	OK620910-06-0010U	09/30/98	Base flow	5.17	7.45	89.5	81.3	60.4	493.02	71	0.68	0.45	0.941	0.24	2.41	3.591
Turkey Creek (upper)	OK620910-06-0010U	10/27/98	Base flow	8.05		72	115	82.4	655.38	61.3	0.356	0.249	1.57	0.033	0.93	2.533
Turkey Creek (upper)	OK620910-06-0010U	03/16/98	Runoff	11.01	7.44	882	17	2		956	0.82	0.284	1.07	0.018	4	
Turkey Creek (upper)	OK620910-06-0010U	07/08/98	Runoff	3.75	7.8	192	166	32.2		259	0.846	0.474	1.85	0.242	3.06	
Turkey Creek (upper)	OK620910-06-0010U	09/22/98	High flow	6.8		960										
Little Turkey Creek	OK620910-06-0020B	12/02/97	Base flow	11.17	8.11	1.3	125	56.2	632.94	0.5	0.046	0.022	7.5	0.048	0.22	7.768
Little Turkey Creek	OK620910-06-0020B	01/13/98	Base flow	12.28	7.91	12.6	124	70.5	804.54	11.8	0.14	0.098	6.92	0.023	0.5	7.443
Little Turkey Creek	OK620910-06-0020B	02/10/98	Base flow	11.71	7.9	9.54	135	61.3	696.3	10.5	0.097	0.067	8.74	0.032	0.392	9.164
Little Turkey Creek	OK620910-06-0020B	04/14/98	Base flow	9.83	7.98	2.94	136	170	764.28	3	0.047	0.015	6.26	0.055	0.57	6.885
Little Turkey Creek	OK620910-06-0020B	05/19/98	Base flow	8.03	7.96	5.06	128	53.8	667.92	5.5	0.12	0.087	5.68	0.087	0.66	6.427
Little Turkey Creek	OK620910-06-0020B	06/16/98	Base flow	8.66	8	4.96	113	55.8	409.2	5.2	0.105	0.054	7.96	0.054	0.64	8.654
Little Turkey Creek	OK620910-06-0020B	07/22/98	Base flow	8.36	8.26	2.77	76	34.1	535.92	6.5	0.081	0.048	8.36	0.083	0.32	8.763
Little Turkey Creek	OK620910-06-0020B	08/18/98	Base flow	7.82	8.02	6.55	72	39.1	520.08	15.5	0.07	0.04	9.2	0.06	0.67	9.93
Little Turkey Creek	OK620910-06-0020B	09/30/98	Base flow	8.05	7.9	7.19	73.5	38.5	528	3.5	0.1	0.06	7.02	0.07	0.99	8.08
Little Turkey Creek	OK620910-06-0020B	10/27/98	Base flow	9.36		2.81	83	54.4	581.46	2	0.072	0.048	7.24	0.037	0.41	7.687
Little Turkey Creek	OK620910-06-0020B	03/16/98	Runoff	10.71	6.98	768	11.9	2		1336	0.67	0.156	0.838	0.013	3.1	
Little Turkey Creek	OK620910-06-0020B	09/22/98	High flow	8.2		161										
Buffalo Creek	OK620910-06-0030G	11/04/97	Base flow	12.82	8.46	3.68	205	164	1123.98	4.5	0.09	0.07	2.5	0.034	0.47	3.004
Buffalo Creek	OK620910-06-0030G	12/02/97	Base flow	7.28	7.94	4.32	225	226	1197.24	4.5	0.098	0.057	1.2	0.023	0.06	1.283
Buffalo Creek	OK620910-06-0030G	01/13/98	Base flow	11.59	8.11	13.2	163	172	1320	13	0.15	0.115	3.62	0.019	0.58	4.219
Buffalo Creek	OK620910-06-0030G	02/10/98	Base flow	11.78	8.09	22.4	180	156	1203.18	27.5	0.131	0.067	3.85	0.027	0.644	4.521
Buffalo Creek	OK620910-06-0030G	04/14/98	Base flow	8.03	8.01	20.1	192	90.7	1201.2	24.5	0.098	0.016	1.1	0.016	0.54	1.656
Buffalo Creek	OK620910-06-0030G	05/19/98	Base flow	4.71	7.88	53.6	191	188	1171.5	63	0.274	0.174	1.21	0.031	0.83	2.071
Buffalo Creek	OK620910-06-0030G	06/16/98	Base flow	7.1	8.1	35.5	243	234	1221	35	0.294	0.18	0.94	0.008	0.86	1.808

Buffalo Creek	OK620910-06-0030G	07/22/98	Base flow	1.79	7.71	20.8	276	178	1570.8	35.8	0.574	0.384	0.804	0.001	1.82	2.625
Buffalo Creek	OK620910-06-0030G	08/18/98	Base flow	5.67	8.08	153	124	163	1073.82	262	0.38	0.055	4.72	0.3	1.46	6.48
Buffalo Creek	OK620910-06-0030G	09/30/98	Base flow	0.46	7.11	222	31	85.7	359.04	83.3	0.62	0.32	0.048	0.004	1.71	1.762
Buffalo Creek	OK620910-06-0030G	10/27/98	Base flow	7.41		186	32	45.4	353.76	105	0.404	0.204	0.33	0.045	1.07	1.445
Buffalo Creek	OK620910-06-0030G	03/16/98	Runoff	10.9	6.52	972	8.4	2		1168	0.79	0.222	0.851	0.017	2.8	
Buffalo Creek	OK620910-06-0030G	09/22/98	High flow	6.8		3415										
Clear Creek	OK620910-06-0110G	11/04/97	Base flow	10.11	8.28	5.78	75	39.2	532.62	7	0.09	0.077	4.4	0.016	0.47	4.886
Clear Creek	OK620910-06-0110G	01/13/98	Base flow	11.72	8.17	18.7	63.8	49	656.04	16.8	0.12	0.075	3.83	0.01	0.47	4.31
Clear Creek	OK620910-06-0110G	02/10/98	Base flow	11.58	7.99	6.86	80	46.8	634.92	8.8	0.086	0.062	4.49	0.012	0.243	4.745
Clear Creek	OK620910-06-0110G	04/14/98	Base flow	8.7	8.08	6.08	60	112	531.3	11	0.104	0.068	3.53	0.016	0.46	4.006
Clear Creek	OK620910-06-0110G	05/19/98	Base flow	7.36	8.14	10.2	70	36.9	528	22	0.178	0.145	3.02	0.024	0.59	3.634
Clear Creek	OK620910-06-0110G	06/16/98	Base flow	8.38	8.31	8.59	95	49.1	528	12.6	0.227	0.168	3.57	0.02	0.63	4.22
Clear Creek	OK620910-06-0110G	07/22/98	Base flow	13.4	8.86	3.05	105	53.9	588.06	7.5	0.145	0.077	0.0671	0.016	0.38	0.4631
Clear Creek	OK620910-06-0110G	08/18/98	Base flow	11.2	8.52	5.69	132	60.8	682.44	8.5	0.14	0.092	1.03	0.03	0.56	1.62
Clear Creek	OK620910-06-0110G	09/30/98	Base flow	8	8.03	2.75	79.5	48.6	572.22	1	0.23	0.2	1.39	0.01	0.57	1.97
Clear Creek	OK620910-06-0110G	10/27/98	Base flow	11.09		2.87	80	53.9	564.3	4	0.116	0.089	2.63	0.015	0.34	2.985
Clear Creek	OK620910-06-0110G	03/16/98	Runoff	11.48	7.71	665	7.7	2		1067	0.77	0.191	0.838	0.014	3.1	
Clear Creek	OK620910-06-0110G	07/08/98	Runoff	7.3	7.89	180	55	69.5		335	0.523	0.199	2.69	0.042	1.94	

Appendix C: Bacteria Data

Site	WBID	Date	Condition	FC / MF colonies/ 100 ml
Turkey Creek Lower	OK620910-06-0010B	11/4/1997	Base flow	80
Turkey Creek (Lower)	OK620910-06-0010B	12/2/1997	Base flow	200
Turkey Creek (Lower)	OK620910-06-0010B	1/13/1998	Base flow	230
Turkey Creek (Lower)	OK620910-06-0010B	2/10/1998	Base flow	80
Turkey Creek (Lower)	OK620910-06-0010B	4/14/1998	Base flow	90
Turkey Creek (Lower)	OK620910-06-0010B	5/19/1998	Base flow	1100
Turkey Creek (Lower)	OK620910-06-0010B	6/16/1998	Base flow	5000
Turkey Creek (Lower)	OK620910-06-0010B	7/22/1998	Base flow	200
Turkey Creek (Lower)	OK620910-06-0010B	8/18/1998	Base flow	200
Turkey Creek (Lower)	OK620910-06-0010B	9/30/1998	Base flow	1300
Turkey Creek (Lower)	OK620910-06-0010B	10/27/1998	Base flow	1100
Turkey Creek (Lower)	OK620910-06-0010B	3/17/1998	High flow	24000
Turkey Creek (Middle)	OK620910-06-0010M	11/4/1997	Base flow	20
Turkey Creek Middle	OK620910-06-0010M	11/4/1997	Base flow	20
Turkey Creek (Middle)	OK620910-06-0010M	12/2/1997	Base flow	200
Turkey Creek (Middle)	OK620910-06-0010M	1/13/1998	Base flow	230
Turkey Creek (Middle)	OK620910-06-0010M	2/10/1998	Base flow	300
Turkey Creek (Middle)	OK620910-06-0010M	4/14/1998	Base flow	170
Turkey Creek (Middle)	OK620910-06-0010M	5/19/1998	Base flow	3000
Turkey Creek (Middle)	OK620910-06-0010M	6/16/1998	Base flow	400
Turkey Creek (Middle)	OK620910-06-0010M	7/22/1998	Base flow	200
Turkey Creek (Middle)	OK620910-06-0010M	8/18/1998	Base flow	200
Turkey Creek (Middle)	OK620910-06-0010M	9/30/1998	Base flow	800
Turkey Creek (Middle)	OK620910-06-0010M	10/27/1998	Base flow	200
Turkey Creek (Middle)	OK620910-06-0010M	3/17/1998	High flow	30000
Turkey Creek (Middle)	OK620910-06-0010M	7/8/1998	High flow	30000
Turkey Creek (Upper)	OK620910-06-0010U	11/4/1997	Base flow	300
Turkey Creek Upper	OK620910-06-0010U	11/4/1997	Base flow	300
Turkey Creek (Upper)	OK620910-06-0010U	1/13/1998	Base flow	130
Turkey Creek (Upper)	OK620910-06-0010U	2/10/1998	Base flow	170
Turkey Creek (Upper)	OK620910-06-0010U	4/14/1998	Base flow	1700
Turkey Creek (Upper)	OK620910-06-0010U	5/19/1998	Base flow	5000
Turkey Creek (Upper)	OK620910-06-0010U	6/16/1998	Base flow	200
Turkey Creek (Upper)	OK620910-06-0010U	7/22/1998	Base flow	400
Turkey Creek (Upper)	OK620910-06-0010U	8/18/1998	Base flow	3000
Turkey Creek (Upper)	OK620910-06-0010U	9/30/1998	Base flow	800
Turkey Creek (Upper)	OK620910-06-0010U	10/27/1998	Base flow	1300
Turkey Creek (Upper)	OK620910-06-0010U	3/16/1998	High flow	50000
Turkey Creek (Upper)	OK620910-06-0010U	7/8/1998	High flow	160000
Little Turkey Creek	OK620910-06-0020B	12/2/1997	Base flow	400
Little Turkey Creek	OK620910-06-0020B	1/13/1998	Base flow	80
Little Turkey Creek	OK620910-06-0020B	2/10/1998	Base flow	300
Little Turkey Creek	OK620910-06-0020B	4/14/1998	Base flow	1100
Little Turkey Creek	OK620910-06-0020B	5/19/1998	Base flow	400
Little Turkey Creek	OK620910-06-0020B	6/16/1998	Base flow	400
Little Turkey Creek	OK620910-06-0020B	7/22/1998	Base flow	3000
Little Turkey Creek	OK620910-06-0020B	8/18/1998	Base flow	800
Little Turkey Creek	OK620910-06-0020B	9/30/1998	Base flow	23
Little Turkey Creek	OK620910-06-0020B	10/27/1998	Base flow	200
Little Turkey Creek	OK620910-06-0020B	3/16/1998	High flow	22000
Buffalo Creek	OK620910-06-0030G	11/4/1997	Base flow	170
Buffalo Creek	OK620910-06-0030G	12/2/1997	Base flow	200
Buffalo Creek	OK620910-06-0030G	1/13/1998	Base flow	1100

Buffalo Creek	OK620910-06-0030G	2/10/1998	Base flow	130
Buffalo Creek	OK620910-06-0030G	4/14/1998	Base flow	40
Buffalo Creek	OK620910-06-0030G	5/19/1998	Base flow	200
Buffalo Creek	OK620910-06-0030G	6/16/1998	Base flow	200
Buffalo Creek	OK620910-06-0030G	7/22/1998	Base flow	2300
Buffalo Creek	OK620910-06-0030G	8/18/1998	Base flow	1100
Buffalo Creek	OK620910-06-0030G	9/30/1998	Base flow	3000
Buffalo Creek	OK620910-06-0030G	10/27/1998	Base flow	5000
Buffalo Creek	OK620910-06-0030G	3/16/1998	High flow	8000
Clear Creek	OK620910-06-0110G	11/4/1997	Base flow	800
Clear Creek	OK620910-06-0110G	1/13/1998	Base flow	500
Clear Creek	OK620910-06-0110G	2/10/1998	Base flow	130
Clear Creek	OK620910-06-0110G	4/14/1998	Base flow	300
Clear Creek	OK620910-06-0110G	5/19/1998	Base flow	800
Clear Creek	OK620910-06-0110G	6/16/1998	Base flow	3000
Clear Creek	OK620910-06-0110G	7/22/1998	Base flow	200
Clear Creek	OK620910-06-0110G	8/18/1998	Base flow	1300
Clear Creek	OK620910-06-0110G	9/30/1998	Base flow	200
Clear Creek	OK620910-06-0110G	10/27/1998	Base flow	2700
Clear Creek	OK620910-06-0110G	3/16/1998	High flow	13000
Clear Creek	OK620910-06-0110G	7/8/1998	High flow	90000

Appendix D: Fish Collection Data

Little Turkey Creek

Metric 1. Total number of species	11			
Metric 2. Number and identity of benthic insectivores				
Phenacobius mirabilis	6			
		# of species	1	
		# of individuals	6	
Metric 3. Number and identity of centrarchid species				
		Lepomis megalotis	13	
Lepomis cyanellus	4			
		Micropterus salmoides	3	
		# of species	3	
		# of individuals	20	
Number and identity of minnow species				
Cyprinella lutrensis	57			
		Notropis stramineus	229	
Hybognathus placitus	7			
		Phenacobius mirabilis	6	
		Pimephales promelas	11	
Notropis atherinoides	14			
		# of species	6	
		# of individuals	324	
Metric 4. Number and identity of intolerant species				
Phenacobius mirabilis	6			
		# of species	1	
		# of individuals	6	
Number and identity of very tolerant species				
Cyprinella lutrensis	57			
Lepomis cyanellus	4			
		# of species	2	
		# of individuals	61	
Metric 5. Proportion of individuals as green sunfish		0.624025		
Metric 6. Proportion of individuals as omnivores		11.23245		
Metric 7. Proportion of individuals as insectivorous cyprinids		38.84555		

Metric 8. Proportion of individuals as top carnivores 0.468019
Metric 9. Number of individuals in sample 641

Metric	Description	IBI Score
1	Total # of sp.	5
2	# of sensitive benthic sp.	5
3	# of centrarchid sp.	5
4	# of sp. with water qual. tolerances	5
5	% of individuals as green sunfish	5
6	% of individuals as omnivores	5
7	% of individuals as insect. cyprinids	3
8	% of individuals as carnivores	1
9	# of individuals in sample	5
	Total =	39

Clear Creek

Metric 1. Total number of species 14
Metric 2. Number and identity of benthic insectivores
Phenacobius mirabilis 26

# of species	1
# of individuals	26

Metric 3. Number and identity of centrarchid species

Lepomis megalotis	47

Lepomis cyanellus 34

Micropterus salmoides	7
# of species	3
# of individuals	88

Number and identity of minnow species
Cyprinella lutrensis 128

Notropis stramineus	405

Hybognathus placitus 8

Phenacobius mirabilis	26
Pimephales promelas	1

	Notropis atherinoides	1		
			# of species	6
			# of individuals	569
Metric 4.	Number and identity of intolerant species			
	Phenacobius mirabilis	26		
			# of species	1
			# of individuals	26
	Number and identity of very tolerant species			
	Cyprinella lutrensis	128		
	Ictalurus melas	14		
	Gambusia affinis	15		
	Lepomis cyanellus	34		
			# of species	4
			# of individuals	191
Metric 5.	Proportion of individuals as green sunfish		3.222749	
Metric 6.	Proportion of individuals as omnivores		15.54502	
Metric 7.	Proportion of individuals as insectivorous cyprinids		40.94787	
Metric 8.	Proportion of individuals as top carnivores		0.663507	
Metric 9.	Number of individuals in sample		1055	

	IBI		
Metric	Description	Score	
1	Total # of sp.	5	
2	# of sensitive benthic sp.	5	
3	# of centrarchid sp.	5	
4	# of sp. with water qual. tolerances	5	
5	% of individuals as green sunfish	5	
6	% of individuals as omnivores	5	
7	% of individuals as insect. cyprinids	3	
8	% of individuals as carnivores	1	
9	# of individuals in sample	5	
		Total =	39

Turkey Creek (upper)

Metric 1. Total number of species	18			
Metric 2. Number and identity of benthic insectivores				
Phenacobius mirabilis	43			
		# of species	1	
		# of individuals	43	
Metric 3. Number and identity of centrarchid species				
		Lepomis megalotis	4	
Lepomis cyanellus	8			
Lepomis humilis	27			
		Micropterus salmoides	1	
		# of species	4	
		# of individuals	40	
Number and identity of minnow species				
Cyprinella lutrensis	615			
		Notropis stramineus	289	
Hybognathus placitus	5			
		Phenacobius mirabilis	43	
		Pimephales promelas	19	
Notropis atherinoides	139	Pimephales vigilax	12	
		# of species	7	
		# of individuals	1122	
Metric 4. Number and identity of intolerant species				
Phenacobius mirabilis	43			
		# of species	1	
		# of individuals	43	
Number and identity of very tolerant species				
Cyprinella lutrensis	615			
Ictalurus melas	1			
Gambusia affinis	30			
Lepomis cyanellus	8			
		# of species	4	
		# of individuals	654	
Metric 5. Proportion of individuals as green sunfish		0.655201		

Metric 6.	Proportion of individuals as omnivores	55.11876
Metric 7.	Proportion of individuals as insectivorous cyprinids	38.57494
Metric 8.	Proportion of individuals as top carnivores	0.2457
Metric 9.	Number of individuals in sample	1221

IBI

Metric	Description	Score	
1	Total # of sp.	5	
2	# of sensitive benthic sp.	5	
3	# of centrarchid sp.	5	
4	# of sp. with water qual. tolerances	5	
5	% of individuals as green sunfish	5	
6	% of individuals as omnivores	1	
7	% of individuals as insect. cyprinids	3	
8	% of individuals as carnivores	1	
9	# of individuals in sample	5	
		Total =	35

Turkey Creek (middle)

Metric 1.	Total number of species	12			
Metric 2.	Number and identity of benthic insectivores				
	Phenacobius mirabilis	25			
				# of species	1
				# of individuals	25
Metric 3.	Number and identity of centrarchid species				
			Lepomis megalotis		8
			Poxomis annularis		1
				# of species	2
				# of individuals	9
	Number and identity of minnow species				
	Cyprinella lutrensis	1167			
			Notropis stramineus		958
	Hybognathus placitus	58			
			Phenacobius mirabilis		25

			Pimephales promelas		53
	Notropis atherinoides	53	Pimephales vigilax		215
				# of species	7
				# of individuals	2529
Metric 4.	Number and identity of intolerant species				
	Phenacobius mirabilis	25			
				# of species	1
				# of individuals	25
	Number and identity of very tolerant species				
	Cyprinella lutrensis	1167			
	Gambusia affinis	54			
				# of species	2
				# of individuals	1221
Metric 5.	Proportion of individuals as green sunfish		0		
Metric 6.	Proportion of individuals as omnivores		53.66492		
Metric 7.	Proportion of individuals as insectivorous cyprinids		38.74346		
Metric 8.	Proportion of individuals as top carnivores		0		
Metric 9.	Number of individuals in sample		2674		

IBI

Metric	Description	Score
1	Total # of sp.	5
2	# of sensitive benthic sp.	3
3	# of centrarchid sp.	3
4	# of sp. with water qual. tolerances	5
5	% of individuals as green sunfish	5
6	% of individuals as omnivores	1
7	% of individuals as insect. cyprinids	3
8	% of individuals as carnivores	1
9	# of individuals in sample	5
	Total =	31

Turkey Creek (lower)

Metric 1.	Total number of species	16

Metric 2.	Number and identity of benthic insectivores				
	Phenacobius mirabilis	1			
				# of species	1
				# of individuals	1
Metric 3.	Number and identity of centrarchid species				
			Lepomis megalotis		1
	Lepomis humilis	1			
	Lepomis macrochirus	1			
				# of species	3
				# of individuals	3
	Number and identity of minnow species				
	Cyprinella lutrensis	479			
	Hybognathus placitus	41			
			Phenacobius mirabilis		1
	Notropis atherinoides	46	Pimephales vigilax		64
				# of species	5
				# of individuals	631
Metric 4.	Number and identity of intolerant species				
	Phenacobius mirabilis	1			
				# of species	1
				# of individuals	1
	Number and identity of very tolerant species				
	Cyprinella lutrensis	479			
	Gambusia affinis	54			
				# of species	2
				# of individuals	533
Metric 5.	Proportion of individuals as green sunfish			0	
Metric 6.	Proportion of individuals as omnivores			84.1637	
Metric 7.	Proportion of individuals as insectivorous cyprinids			4.982206	
Metric 8.	Proportion of individuals as top carnivores			0.177936	
Metric 9.	Number of individuals in sample			1124	
	IBI				
Metric	Description	Score			

1	Total # of sp.	5
2	# of sensitive benthic sp.	3
3	# of centrarchid sp.	5
4	# of sp. with water qual. tolerances	5
5	% of individuals as green sunfish	5
6	% of individuals as omnivores	1
7	% of individuals as insect. cyprinids	1
8	% of individuals as carnivores	1
9	# of individuals in sample	5
	Total =	31

Buffalo Creek

Metric 1. Total number of species 17

Metric 2. Number and identity of benthic insectivores

Phenacobius mirabilis	19

# of species	1
# of individuals	19

Metric 3. Number and identity of centrarchid species

Lepomis megalotis	5
Lepomis cyanellus	8
Lepomis humilis	14
Lepomis macrochirus	1
Micropterus salmoides	1

# of species	5
# of individuals	29

Number and identity of minnow species

Cyprinella lutrensis	420
Notropis stramineus	141
Hybognathus placitus	42
Phenacobius mirabilis	19
Pimephales promelas	12
Notemigonus crysoleucas	6
Notropis atherinoides	4
Pimephales vigilax	9

# of species	8

				# of individuals	653
Metric 4.	Number and identity of intolerant species				
	Phenacobius mirabilis	19			
				# of species	1
				# of individuals	19
	Number and identity of very tolerant species				
	Cyprinella lutrensis	420			
	Ictalurus melas	1			
	Gambusia affinis	63			
	Lepomis cyanellus	8			
				# of species	4
				# of individuals	492
Metric 5.	Proportion of individuals as green sunfish			1.026958	
Metric 6.	Proportion of individuals as omnivores			59.05006	
Metric 7.	Proportion of individuals as insectivorous cyprinids			21.05263	
Metric 8.	Proportion of individuals as top carnivores			0.12837	
Metric 9.	Number of individuals in sample			779	
	IBI				
Metric	Description		Score		
1	Total # of sp.		5		
2	# of sensitive benthic sp.		3		
3	# of centrarchid sp.		5		
4	# of sp. with water qual. tolerances		5		
5	% of individuals as green sunfish		5		
6	% of individuals as omnivores		1		
7	% of individuals as insect. cyprinids		3		
8	% of individuals as carnivores		1		
9	# of individuals in sample		5		
			Total =	33	

References

Griever Creek

Metric 1.	Total number of species	12

Metric 2.	Number and identity of benthic insectivores			
	Phenacobius mirabilis	37		
			# of species	1
			# of individuals	37
Metric 3.	Number and identity of centrarchid species			
			Lepomis megalotis	30
	Lepomis cyanellus	12		
	Lepomis humilis	8		
	Lepomis macrochirus	5		
			# of species	4
			# of individuals	55
	Number and identity of minnow species			
	Cyprinella lutrensis	270		
			Notropis stramineus	68
	Hybognathus placitus	7		
			Phenacobius mirabilis	37
			Pimephales promelas	22
	Notropis atherinoides	87		
			# of species	6
			# of individuals	491
Metric 4.	Number and identity of intolerant species			
	Phenacobius mirabilis	37		
			# of species	1
			# of individuals	37
	Number and identity of very tolerant species			
	Cyprinella lutrensis	270		
	Lepomis cyanellus	12		
			# of species	2
			# of individuals	282
Metric 5.	Proportion of individuals as green sunfish		2.181818	
Metric 6.	Proportion of individuals as omnivores		55.45455	
Metric 7.	Proportion of individuals as insectivorous cyprinids		34.90909	
Metric 8.	Proportion of individuals as top carnivores		0	

Metric 9. Number of individuals in sample 550

IBI

Metric	Description	Score
1	Total # of sp.	5
2	# of sensitive benthic sp.	5
3	# of centrarchid sp.	5
4	# of sp. with water qual. tolerances	5
5	% of individuals as green sunfish	5
6	% of individuals as omnivores	1
7	% of individuals as insect. cyprinids	3
8	% of individuals as carnivores	1
9	# of individuals in sample	5
	Total =	35

Unnamed Tributary of the South Canadian River

Metric 1. Total number of species 11

Metric 2. Number and identity of benthic insectivores

Phenacobius mirabilis 124

# of species	1
# of individuals	124

Metric 3. Number and identity of centrarchid species

Lepomis megalotis		4
Lepomis cyanellus	11	
Micropterus salmoides		15
# of species		3
# of individuals		30

Number and identity of minnow species

Cyprinella lutrensis 75

Notropis stramineus	123
Phenacobius mirabilis	124
Pimephales promelas	52
Pimephales vigilax	15
# of species	5

				# of individuals	389
Metric 4.	Number and identity of intolerant species				
	Phenacobius mirabilis	124			
				# of species	1
				# of individuals	124
	Number and identity of very tolerant species				
	Cyprinella lutrensis	75			
	Gambusia affinis	3			
	Lepomis cyanellus	11			
				# of species	3
				# of individuals	89
Metric 5.	Proportion of individuals as green sunfish		2.244898		
Metric 6.	Proportion of individuals as omnivores		33.26531		
Metric 7.	Proportion of individuals as insectivorous cyprinids		50.40816		
Metric 8.	Proportion of individuals as top carnivores		3.061224		
Metric 9.	Number of individuals in sample		490		

	IBI		
Metric	Description	Score	
1	Total # of sp.	5	
2	# of sensitive benthic sp.	5	
3	# of centrarchid sp.	5	
4	# of sp. with water qual. tolerances	5	
5	% of individuals as green sunfish	5	
6	% of individuals as omnivores	3	
7	% of individuals as insect. cyprinids	5	
8	% of individuals as carnivores	3	
9	# of individuals in sample	5	
		Total =	41

Otter Creek

Metric 1.	Total number of species	15	
Metric 2.	Number and identity of benthic insectivores		
	Campostoma anomalum	8	

	Phenacobius mirabilis	47		
			# of species	2
			# of individuals	55
Metric 3.	Number and identity of centrarchid species			
			Lepomis megalotis	4
	Lepomis humilis	3		
			Micropterus salmoides	2
			# of species	3
			# of individuals	9
	Number and identity of minnow species			
	Campostoma anomalum	8		
	Cyprinella lutrensis	515		
			Notropis stramineus	2
			Phenacobius mirabilis	47
	Notropis atherinoides	1	Pimephales vigilax	33
			# of species	6
			# of individuals	606
Metric 4.	Number and identity of intolerant species			
	Phenacobius mirabilis	47		
			# of species	1
			# of individuals	47
	Number and identity of very tolerant species			
	Cyprinella lutrensis	515		
	Gambusia affinis	1		
			# of species	2
			# of individuals	516
Metric 5.	Proportion of individuals as green sunfish		0	
Metric 6.	Proportion of individuals as omnivores		87.69716	
Metric 7.	Proportion of individuals as insectivorous cyprinids		7.886435	
Metric 8.	Proportion of individuals as top carnivores		1.735016	
Metric 9.	Number of individuals in sample		634	
	IBI			
Metric	Description	Score		

1	Total # of sp.	5
2	# of sensitive benthic sp.	5
3	# of centrarchid sp.	5
4	# of sp. with water qual. tolerances	5
5	% of individuals as green sunfish	5
6	% of individuals as omnivores	1
7	% of individuals as insect. cyprinids	1
8	% of individuals as carnivores	3
9	# of individuals in sample	5
	Total =	35

Red Rock Creek

Metric 1. Total number of species 16

Metric 2. Number and identity of benthic insectivores

Phenacobius mirabilis 4

# of species 1
# of individuals 4

Metric 3. Number and identity of centrarchid species

Lepomis megalotis 6

Lepomis cyanellus 26
Lepomis humilis 6

Micropterus salmoides 1

# of species 4
# of individuals 39

Number and identity of minnow species

Cyprinella lutrensis 21

Phenacobius mirabilis 4

# of species 2
# of individuals 25

Metric 4. Number and identity of intolerant species

Phenacobius mirabilis 4

# of species 1
# of individuals 4

	Number and identity of very tolerant species				
	Cyprinella lutrensis	21			
	Gambusia affinis	19			
	Lepomis cyanellus	26			
				# of species	3
				# of individuals	66
Metric 5.	Proportion of individuals as green sunfish		26.53061		
Metric 6.	Proportion of individuals as omnivores		53.06122		
Metric 7.	Proportion of individuals as insectivorous cyprinids		4.081633		
Metric 8.	Proportion of individuals as top carnivores		4.081633		
Metric 9.	Number of individuals in sample		98		

IBI

Metric	Description	Score
1	Total # of sp.	5
2	# of sensitive benthic sp.	3
3	# of centrarchid sp.	5
4	# of sp. with water qual. tolerances	5
5	% of individuals as green sunfish	1
6	% of individuals as omnivores	1
7	% of individuals as insect. cyprinids	1
8	% of individuals as carnivores	3
9	# of individuals in sample	1
	Total =	25

Sandy Creek

Metric 1.	Total number of species	14			
Metric 2.	Number and identity of benthic insectivores				
	Campostoma anomalum	12			
	Phenacobius mirabilis	4			
				# of species	2
				# of individuals	16
Metric 3.	Number and identity of centrarchid species				
			Lepomis megalotis		4

	Lepomis cyanellus	31			
	Lepomis humilis	1			
			Micropterus salmoides		2
				# of species	4
				# of individuals	38
	Number and identity of minnow species				
	Campostoma anomalum	12			
	Cyprinella lutrensis	424			
			Notropis stramineus		35
			Phenacobius mirabilis		4
			Pimephales promelas		4
	Notemigonus crysoleucas	2			
				# of species	6
				# of individuals	481
Metric 4.	Number and identity of intolerant species				
	Phenacobius mirabilis	4			
				# of species	1
				# of individuals	4
	Number and identity of very tolerant species				
	Cyprinella lutrensis	424			
	Lepomis cyanellus	31			
				# of species	2
				# of individuals	455
Metric 5.	Proportion of individuals as green sunfish			5.024311	
Metric 6.	Proportion of individuals as omnivores			82.49595	
Metric 7.	Proportion of individuals as insectivorous cyprinids			6.320908	
Metric 8.	Proportion of individuals as top carnivores			0.324149	
Metric 9.	Number of individuals in sample			617	

	IBI	
Metric	Description	Score
1	Total # of sp.	5
2	# of sensitive benthic sp.	5
3	# of centrarchid sp.	5

4	# of sp. with water qual. tolerances	5	
5	% of individuals as green sunfish	5	
6	% of individuals as omnivores	1	
7	% of individuals as insect. cyprinids	1	
8	% of individuals as carnivores	1	
9	# of individuals in sample	5	
		Total =	33

Appendix E: Macroinvertebrate Collection Data

Stream name: Little Turkey Creek
Date: 35825
Waterbody ID#: OK620910-06-0020B
Sample ID#: 20872

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	121	122	117	360
2	Number of taxa	10	9	14	21
3	Density/1 minute effort	1882.222	569.3333	728	1059.852
4	Modified Hilsenhoff biotic index	5.628099	5.655738	5.65812	5.647222
5	Modified North Carolina biotic index	4.835569	4.640578	5.149254	4.871436
6	Scrapers/scrapers + filtering collectors	0.020408	0.023256	0.047619	0.026549
7	Scrapers and filtering collectors/total	0.202479	0.17623	0.089744	0.156944
8	Shredders/total	0	0	0	0
9	Gathering collectors/total	0.772727	0.815574	0.893162	0.826389
10	Chironomidae/total	0.61157	0.639344	0.478632	0.577778
11	EPT/EPT + Chironomidae	0.177778	0.242718	0.42268	0.282759
12	EPT/EPT + Chronomini	1	0.961538	0.953488	0.964706
13	EPT/total	0.132231	0.204918	0.350427	0.227778
14	EPT taxa	1	3	4	5
15	Dominants/total	0.61157	0.631148	0.418803	0.555556
16	Shannon-Weaver diversity index	1.748557	1.676794	2.511481	2.165564

Organisms collected -

Ref. #				Taxon	# Riffle	# Woody	# Vegetation	Total
14			Haplotaxida	Nais			2	2
19			Haplotaxida	Limnodrilus	1		2	3
28			Amphipoda	Hyalella			5	5
48 *	^	…	Coleoptera	Agabus		1		1
54			Coleoptera	Dubiraphia	1	1	1	3
55			Coleoptera	Heterelmis		1		1

60				Coleoptera	Stenelmis	2			2
66	*	^	…	Coleoptera	Peltodytes		1		1
70	*	^	…	Coleoptera	Berosus			1	1
82	*			Coleoptera	Scirtidae			1	1
87				Diptera	Ceratopogonidae			1	1
90				Diptera	Chironomini		1	2	3
92				Diptera	Orthocladiinae	74	77	49	200
94				Diptera	Tanypodinae			2	2
95				Diptera	Tanytarsini			3	3
104				Diptera	Simulium	22	16	9	47
116				Diptera	Gonomyia	2			2
126.6				Ephemeroptera	Fallceon	16	20	33	69
131				Ephemeroptera	Caenis			6	6
141				Ephemeroptera	Stenacron		1	1	2
142.4				Ephemeroptera	Isonychia		4		4
191				Odonata	Progomphus	1			1
228				Trichoptera	Cheumatopsyche	1	1		2
229				Trichoptera	Hydropsyche			1	1
279				Veneroida	Sphaerium	1			1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Little Turkey Creek
Date:	36014
Waterbody ID#:	OK620910-06-0020B
Sample ID#:	20944

Metric #	Description	Woody
1	Number of organisms	126
2	Number of taxa	15
3	Density/1 minute effort	1128.96

4				Modified Hilsenhoff biotic index	5.52381
5				Modified North Carolina biotic index	5.449186
6				Scrapers/scrapers + filtering collectors	0.175
7				Scrapers and filtering collectors/total	0.31746
8				Shredders/total	0
9				Gathering collectors/total	0.630952
10				Chironomidae/total	0.214286
11				EPT/EPT + Chironomidae	0.72449
12				EPT/EPT + Chronomini	0.763441
13				EPT/total	0.563492
14				EPT taxa	6
15				Dominants/total	0.190476
16				Shannon-Weaver diversity index	3.331194

Organisms collected -

Ref. #					Taxon	# Woody
55				Coleoptera	Heterelmis	13
75	*	^	…	Coleoptera	Paracymus	1
83	*	^	…	Coleoptera	Scirtes	2
87.5				Diptera	Atrichopogon	1
90				Diptera	Chironomini	22
94				Diptera	Tanypodinae	3
95				Diptera	Tanytarsini	2
109.5				Diptera	Stratiomys	1
126.6				Ephemeroptera	Fallceon	4
131				Ephemeroptera	Caenis	17
142.4				Ephemeroptera	Isonychia	6
151				Ephemeroptera	Tricorythodes	17
191				Odonata	Progomphus	3
228				Trichoptera	Cheumatopsyche	3
229				Trichoptera	Hydropsyche	24

238	Trichoptera	Nectopsyche	3
267	Basommatophora	Physella	7

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name: Clear Creek
Date: 35824
Waterbody ID#: OK620910-06-0110G
Sample ID#: 20867

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	113	126	106	345
2	Number of taxa	17	11	11	20
3	Density/1 minute effort	1406.222	504	706.6667	872.2963
4	Modified Hilsenhoff biotic index	5.637168	5.634921	5.924528	5.724638
5	Modified North Carolina biotic index	4.761796	4.657872	5.14206	4.840676
6	Scrapers/scrapers + filtering collectors	0.0625	0	0	0.021277
7	Scrapers and filtering collectors/total	0.141593	0.103175	0.169811	0.136232
8	Shredders/total	0.00885	0	0	0.002899
9	Gathering collectors/total	0.734513	0.785714	0.679245	0.736232
10	Chironomidae/total	0.654867	0.706349	0.415094	0.6
11	EPT/EPT + Chironomidae	0.204301	0.205357	0.413333	0.260714
12	EPT/EPT + Chronomini	0.95	0.851852	0.775	0.83908
13	EPT/total	0.168142	0.18254	0.292453	0.211594
14	EPT taxa	5	3	4	5
15	Dominants/total	0.610619	0.65873	0.264151	0.521739
16	Shannon-Weaver diversity index	2.214667	1.858038	2.997689	2.561997

Organisms collected -

Ref. #	Taxon	# Riffle	# Woody	# Vegetation	Total

7	^	…	Haplotaxida	Enchytraeidae	2	1		3
28			Amphipoda	Hyalella			13	13
45			Coleoptera	Helichus	1			1
60			Coleoptera	Stenelmis	1			1
90			Diptera	Chironomini	1	4	9	14
91			Diptera	Diamesinae	1			1
92			Diptera	Orthocladiinae	69	83	28	180
93			Diptera	Pseudochironomi	1			1
94			Diptera	Tanypodinae	2	1	4	7
95			Diptera	Tanytarsini		1	3	4
99			Diptera	Hemerodromia		1		1
104			Diptera	Simulium	13	7	16	36
116			Diptera	Gonomyia	1			1
126.6			Ephemeroptera	Fallceon	5	9	13	27
131			Ephemeroptera	Caenis	1		2	3
141			Ephemeroptera	Stenacron	10	13	14	37
142.4			Ephemeroptera	Isonychia	1	1	2	4
177			Odonata	Hetaerina	1		2	3
228			Trichoptera	Cheumatopsyche	1	5		6
234			Trichoptera	Hydroptila	2			2

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Clear Creek
Date:	36041
Waterbody ID#:	OK620910-06-0110G
Sample ID#:	20955

Metric #	Description	Riffle	Vegetation	Pooled
1	Number of organisms	114	93	207
2	Number of taxa	12	12	18
3	Density/1 minute effort	2553.6	1736	2144.8

4			Modified Hilsenhoff biotic index	5.561404	6.516129	5.990338	
5			Modified North Carolina biotic index	6.178099	6.882875	6.494737	
6			Scrapers/scrapers + filtering collectors	1	1	1	
7			Scrapers and filtering collectors/total	0.070175	0.290323	0.169082	
8			Shredders/total	0	0.021505	0.009662	
9			Gathering collectors/total	0.758772	0.623656	0.698068	
10			Chironomidae/total	0.412281	0.290323	0.357488	
11			EPT/EPT + Chironomidae	0.373333	0.5	0.426357	
12			EPT/EPT + Chronomini	0.903226	0.931034	0.916667	
13			EPT/total	0.245614	0.290323	0.2657	
14			EPT taxa	3	3	5	
15			Dominants/total	0.385965	0.236559	0.318841	
16			Shannon-Weaver diversity index	2.819111	2.881989	3.165329	

Organisms collected -

Ref. #				Taxon	# Riffle	# Vegetation	Total
19			Haplotaxida	Limnodrilus	1		1
28			Amphipoda	Hyalella	10	13	23
45			Coleoptera	Helichus		2	2
60			Coleoptera	Stenelmis	7		7
66 *	^	…	Coleoptera	Peltodytes		8	8
70 *	^	…	Coleoptera	Berosus	1	1	2
71 *	^	…	Coleoptera	Enochrus	1		1
76 *	^	…	Coleoptera	Tropisternus	1	1	2
78.6 *	^	…	Coleoptera	Pronoterus	1		1
90			Diptera	Chironomini	3	2	5
93			Diptera	Pseudochironomi		3	3
94			Diptera	Tanypodinae	44	22	66
110.5			Diptera	Chrysops	1		1
117.5			Diptera	Limnophila	6		6
126.6			Ephemeroptera	Fallceon	19		19

128			Ephemeroptera	Paracloeodes			7	7
131			Ephemeroptera	Caenis	8		18	26
143			Ephemeroptera	Leptophlebiidae	1			1
153	*	^	…	Hemiptera	Corixidae		1	1
184.1				Odonata	Arigomphus		1	1
187				Odonata	Gomphus		2	2
191				Odonata	Progomphus	6	1	7
238				Trichoptera	Nectopsyche		2	2
267				Basommatophora	Physella	8	20	28

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Turkey Upper
Date:	35824
Waterbody ID#:	OK620910-06-0010U
Sample ID#:	20868

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	98	99	116	313
2	Number of taxa	13	9	11	18
3	Density/1 minute effort	415.7576	277.2	962.3704	551.776
4	Modified Hilsenhoff biotic index	5.897959	5.666667	5.939655	5.840256
5	Modified North Carolina biotic index	5.554459	4.849815	4.765156	5.039063
6	Scrapers/scrapers + filtering collectors	0	0	0.071429	0.014493
7	Scrapers and filtering collectors/total	0.183673	0.373737	0.12069	0.220447
8	Shredders/total	0	0	0	0
9	Gathering collectors/total	0.755102	0.565657	0.844828	0.728435
10	Chironomidae/total	0.408163	0.565657	0.836207	0.616613
11	EPT/EPT + Chironomidae	0.166667	0.211268	0.067308	0.134529
12	EPT/EPT + Chronomini	0.727273	0.9375	0.583333	0.769231
13	EPT/total	0.081633	0.151515	0.060345	0.095847
14	EPT taxa	3	3	3	4

15	Dominants/total	0.357143	0.383838	0.698276	0.492013		
16	Shannon-Weaver diversity index	2.820612	2.456873	1.800178	2.678252		

Organisms collected -

Ref. #			Taxon	# Riffle	# Woody	# Vegetation	Total
7	^	… Haplotaxida	Enchytraeidae	1			1
19		Haplotaxida	Limnodrilus	12			12
20		Haplotaxida	Tubifex	1			1
90		Diptera	Chironomini	3	1	5	9
92		Diptera	Orthocladiinae	35	38	81	154
94		Diptera	Tanypodinae	2	13	7	22
95		Diptera	Tanytarsini		4	4	8
99		Diptera	Hemerodromia	1			1
104		Diptera	Simulium	16	24	7	47
115.5		Diptera	Erioptera	5			5
116		Diptera	Gonomyia	14			14
123		Ephemeroptera	Baetis	1		1	2
141		Ephemeroptera	Stenacron	5	6	3	14
142.4		Ephemeroptera	Isonychia	2	1		3
179		Odonata	Argia			1	1
228		Trichoptera	Cheumatopsyche		4	3	7
229		Trichoptera	Hydropsyche		8	3	11
263		Basommatophora	Lymnaeidae			1	1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Turkey Upper
Date:	36041
Waterbody ID#:	OK620910-06-0010U
Sample ID#:	20954

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	122	110	90	322
2	Number of taxa	14	17	13	22
3	Density/1 minute effort	3795.556	1777.778	727.2727	2100.202
4	Modified Hilsenhoff biotic index	6.295082	6.845455	7.188889	6.732919
5	Modified North Carolina biotic index	5.702376	5.759366	6.227161	5.868524
6	Scrapers/scrapers + filtering collectors	0.105263	0.333333	0.860465	0.470588
7	Scrapers and filtering collectors/total	0.155738	0.095455	0.238889	0.158385
8	Shredders/total	0	0	0	0
9	Gathering collectors/total	0.827869	0.868182	0.683333	0.801242
10	Chironomidae/total	0.737705	0.809091	0.633333	0.732919
11	EPT/EPT + Chironomidae	0.117647	0.127451	0.136364	0.125926
12	EPT/EPT + Chronomini	0.25	0.188406	0.157895	0.195402
13	EPT/total	0.098361	0.118182	0.1	0.10559
14	EPT taxa	4	7	4	9
15	Dominants/total	0.336066	0.509091	0.533333	0.434783
16	Shannon-Weaver diversity index	2.734042	2.469913	2.265209	2.81694

Organisms collected -

Ref. #				Taxon	# Riffle	# Woody	# Vegetation	Total
19			Haplotaxida	Limnodrilus		1		1
54			Coleoptera	Dubiraphia			1	1
60			Coleoptera	Stenelmis	2	2	2	6
70 *	^	…	Coleoptera	Berosus	1	1	2	4
75 *	^	…	Coleoptera	Paracymus		1		1
83 *	^	…	Coleoptera	Scirtes			1	1
87.5			Diptera	Atrichopogon		1		1
87.75			Diptera	Dasyhelea	1			1
90			Diptera	Chironomini	36	56	48	140
92			Diptera	Orthocladiinae	7	1		8

93			Diptera	Pseudochironomi	6	11	2	19
94			Diptera	Tanypodinae	41	21	7	69
123			Ephemeroptera	Baetis		1	1	2
126.6			Ephemeroptera	Fallceon	9	1	2	12
128			Ephemeroptera	Paracloeodes		1		1
131			Ephemeroptera	Caenis		1		1
141			Ephemeroptera	Stenacron			5	5
151			Ephemeroptera	Tricorythodes	1	2	1	4
153 *	^	…	Hemiptera	Corixidae		10		10
155 *	^	…	Hemiptera	Rheumatobates			3	3
159 *	^	…	Hemiptera	Rhagovelia		1	1	2
228			Trichoptera	Cheumatopsyche	9	1	1	11
229			Trichoptera	Hydropsyche	1	4		5
231			Trichoptera	Smicridea	1			1
234			Trichoptera	Hydroptila		3		3
267			Basommatophora	Physella	2	1	18	21
275			Veneroida	Corbicula	2		1	3
279			Veneroida	Sphaerium	4	2	1	7

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Turkey Middle
Date:	35824
Waterbody ID#:	OK620910-06-0010M
Sample ID#:	20413

Metric #	Description	Woody	Vegetation	Pooled
1	Number of organisms	128	94	222
2	Number of taxa	13	13	17
3	Density/1 minute effort	716.8	584.8889	650.8444
4	Modified Hilsenhoff biotic index	5.8125	5.553191	5.702703
5	Modified North Carolina biotic index	4.655858	4.800415	4.717067

6			Scrapers/scrapers + filtering collectors	0	0.030303	0.011236
7			Scrapers and filtering collectors/total	0.21875	0.175532	0.20045
8			Shredders/total	0	0	0
9			Gathering collectors/total	0.742188	0.590426	0.677928
10			Chironomidae/total	0.726563	0.446809	0.608108
11			EPT/EPT + Chironomidae	0.122642	0.468354	0.27027
12			EPT/EPT + Chronomini	0.866667	0.973684	0.943396
13			EPT/total	0.101563	0.393617	0.225225
14			EPT taxa	6	5	7
15			Dominants/total	0.679688	0.382979	0.554054
16			Shannon-Weaver diversity index	1.86325	2.843313	2.50661

Organisms collected -

Ref. #				Taxon	# Woody	# Vegetation	Total
28			Amphipoda	Hyalella	1	1	2
54			Coleoptera	Dubiraphia		1	1
62 *	^	…	Coleoptera	Dineutus		2	2
70 *	^	…	Coleoptera	Berosus		1	1
82 *			Coleoptera	Scirtidae		1	1
90			Diptera	Chironomini	2	1	3
92			Diptera	Orthocladiinae	87	36	123
94			Diptera	Tanypodinae		5	5
95			Diptera	Tanytarsini	4		4
99			Diptera	Hemerodromia	1		1
104			Diptera	Simulium	15	7	22
126.6			Ephemeroptera	Fallceon	1	7	8
131			Ephemeroptera	Caenis		5	5
141			Ephemeroptera	Stenacron	3	19	22
142			Ephemeroptera	Stenonema	1		1
142.4			Ephemeroptera	Isonychia	2	4	6
179			Odonata	Argia		3	3

228	Trichoptera	Cheumatopsyche	5	3	8
229	Trichoptera	Hydropsyche	4	2	6
230	Trichoptera	Potamyia	2		2

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Turkey Middle
Date:	36014
Waterbody ID#:	OK620910-06-0010M
Sample ID#:	20945

Metric #	Description	Woody
1	Number of organisms	121
2	Number of taxa	15
3	Density/1 minute effort	2710.4
4	Modified Hilsenhoff biotic index	6.487603
5	Modified North Carolina biotic index	5.352673
6	Scrapers/scrapers + filtering collectors	0.04
7	Scrapers and filtering collectors/total	0.206612
8	Shredders/total	0.008264
9	Gathering collectors/total	0.772727
10	Chironomidae/total	0.669421
11	EPT/EPT + Chironomidae	0.289474
12	EPT/EPT + Chronomini	0.336735
13	EPT/total	0.272727
14	EPT taxa	6
15	Dominants/total	0.53719
16	Shannon-Weaver diversity index	2.344907

Organisms collected -

Ref. #				Taxon	# Woody
45			Coleoptera	Helichus	1
60			Coleoptera	Stenelmis	1
75 *	^	…	Coleoptera	Paracymus	1
87.5			Diptera	Atrichopogon	1
90			Diptera	Chironomini	65
93			Diptera	Pseudochironomi	1
94			Diptera	Tanypodinae	3
95			Diptera	Tanytarsini	12
126.6			Ephemeroptera	Fallceon	3
128			Ephemeroptera	Paracloeodes	1
131			Ephemeroptera	Caenis	1
151			Ephemeroptera	Tricorythodes	8
153 *	^	…	Hemiptera	Corixidae	1
228			Trichoptera	Cheumatopsyche	3
229			Trichoptera	Hydropsyche	19
250			Trichoptera	Cyrnellus	1
275			Veneroida	Corbicula	1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Turkey Lower
Date:	35825
Waterbody ID#:	OK620910-06-0010B
Sample ID#:	20876

Metric #	Description	Riffle	Woody	Pooled
1	Number of organisms	104	137	241
2	Number of taxa	8	11	13
3	Density/1 minute effort	173.3333	383.6	278.4667
4	Modified Hilsenhoff biotic index	5.105769	6.284672	5.775934

5			Modified North Carolina biotic index	5.103018	4.917592	4.99761
6			Scrapers/scrapers + filtering collectors	0	0	0
7			Scrapers and filtering collectors/total	0.192308	0.109489	0.145228
8			Shredders/total	0	0	0
9			Gathering collectors/total	0.807692	0.861314	0.838174
10			Chironomidae/total	0.471154	0.854015	0.688797
11			EPT/EPT + Chironomidae	0.075472	0.071429	0.072626
12			EPT/EPT + Chronomini	1	0.243243	0.317073
13			EPT/total	0.038462	0.065693	0.053942
14			EPT taxa	1	4	4
15			Dominants/total	0.413462	0.525547	0.477178
16			Shannon-Weaver diversity index	2.140203	2.180599	2.500334

Organisms collected -

Ref. #					Taxon	# Riffle	# Woody	Total
19				Haplotaxida	Limnodrilus	2		2
90				Diptera	Chironomini		28	28
92				Diptera	Orthocladiinae	43	72	115
94				Diptera	Tanypodinae	5	11	16
95				Diptera	Tanytarsini	1	6	7
96	*	^	…	Diptera	Dolichopodidae	1		1
99				Diptera	Hemerodromia		1	1
104				Diptera	Simulium	13	9	22
116				Diptera	Gonomyia	33		33
126.6				Ephemeroptera	Fallceon		1	1
142				Ephemeroptera	Stenonema		3	3
142.4				Ephemeroptera	Isonychia	4	1	5
228				Trichoptera	Cheumatopsyche	3	1	4
229				Trichoptera	Hydropsyche		4	4

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index

… - taxon excluded from North Carolina biotic index

Stream name:	Turkey Lower
Date:	36013
Waterbody ID#:	OK620910-06-0010B
Sample ID#:	20943

Metric #	Description	Woody
1	Number of organisms	158
2	Number of taxa	6
3	Density/1 minute effort	3539.2
4	Modified Hilsenhoff biotic index	7.493671
5	Modified North Carolina biotic index	5.484999
6	Scrapers/scrapers + filtering collectors	0
7	Scrapers and filtering collectors/total	0.006329
8	Shredders/total	0
9	Gathering collectors/total	0.987342
10	Chironomidae/total	0.981013
11	EPT/EPT + Chironomidae	0.012739
12	EPT/EPT + Chronomini	0.01626
13	EPT/total	0.012658
14	EPT taxa	2
15	Dominants/total	0.765823
16	Shannon-Weaver diversity index	1.022837

Organisms collected -

Ref. #					Taxon	# Woody
71	*	^	…	Coleoptera	Enochrus	1
90				Diptera	Chironomini	121
92				Diptera	Orthocladiinae	4

95				Diptera	Tanytarsini	30
131				Ephemeroptera	Caenis	1
153	*	^	…	Hemiptera	Corixidae	3
159	*	^	…	Hemiptera	Rhagovelia	1
187				Odonata	Gomphus	1
229				Trichoptera	Hydropsyche	1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Buffalo Creek
Date:	35824
Waterbody ID#:	OK620910-06-0030G
Sample ID#:	20866

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	102	119	114	335
2	Number of taxa	11	15	15	22
3	Density/1 minute effort	2380	888.5333	851.2	1373.244
4	Modified Hilsenhoff biotic index	6.362745	5.991597	6.201754	6.176119
5	Modified North Carolina biotic index	5.635692	4.934993	5.366625	5.295224
6	Scrapers/scrapers + filtering collectors	0	0.034483	0.020408	0.014493
7	Scrapers and filtering collectors/total	0.490196	0.243697	0.214912	0.308955
8	Shredders/total	0	0	0	0
9	Gathering collectors/total	0.470588	0.701681	0.758772	0.650746
10	Chironomidae/total	0.372549	0.655462	0.578947	0.543284
11	EPT/EPT + Chironomidae	0.116279	0.093023	0.09589	0.09901
12	EPT/EPT + Chronomini	0.714286	0.571429	0.777778	0.666667
13	EPT/total	0.04902	0.067227	0.061404	0.059701
14	EPT taxa	2	4	2	4
15	Dominants/total	0.333333	0.554622	0.54386	0.480597
16	Shannon-Weaver diversity index	2.497316	2.225443	2.337899	2.588231

Organisms collected -

Ref. #					Taxon	# Riffle	# Woody	# Vegetation	Total
3			…	Pharyngobdellida	Erpobdellidae	1			1
7		^	…	Haplotaxida	Enchytraeidae			3	3
14				Haplotaxida	Nais		1	1	2
17.4				Haplotaxida	Stylaria			1	1
19				Haplotaxida	Limnodrilus	5		1	6
28				Amphipoda	Hyalella		2	7	9
48	*	^	…	Coleoptera	Agabus			1	1
54				Coleoptera	Dubiraphia		1	1	2
60				Coleoptera	Stenelmis	3			3
70	*	^	…	Coleoptera	Berosus		1	1	2
87				Diptera	Ceratopogonidae			2	2
90				Diptera	Chironomini	2	6	2	10
92				Diptera	Orthocladiinae	33	66	62	161
94				Diptera	Tanypodinae	3	3		6
95				Diptera	Tanytarsini		3	2	5
104				Diptera	Simulium	34	25	22	81
126.6				Ephemeroptera	Fallceon	4	1	4	9
131				Ephemeroptera	Caenis	1	1	3	5
141				Ephemeroptera	Stenacron		5		5
179				Odonata	Argia			1	1
228				Trichoptera	Cheumatopsyche	2	2		4
234				Trichoptera	Hydroptila		1		1
279				Veneroida	Sphaerium	14	1	2	17
285			…	Tricladida	Planariidae		1		1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

REFERENCES

Stream name: Griever Creek
Date: 35856
Waterbody ID#: OK620920-01-0130G
Sample ID#: 20912

Metric #	Description	Riffle	Vegetation	Pooled
1	Number of organisms	144	119	263
2	Number of taxa	7	13	15
3	Density/1 minute effort	2560	2613.333	2586.667
4	Modified Hilsenhoff biotic index	5.881944	6.084034	5.973384
5	Modified North Carolina biotic index	4.668106	5.035774	4.834465
6	Scrapers/scrapers + filtering collectors	0	0.105263	0.076923
7	Scrapers and filtering collectors/total	0.048611	0.159664	0.098859
8	Shredders/total	0	0	0
9	Gathering collectors/total	0.9375	0.831933	0.889734
10	Chironomidae/total	0.861111	0.697479	0.787072
11	EPT/EPT + Chironomidae	0.074627	0.077778	0.075893
12	EPT/EPT + Chronomini	0.833333	0.777778	0.809524
13	EPT/total	0.069444	0.058824	0.064639
14	EPT taxa	1	2	2
15	Dominants/total	0.840278	0.613445	0.737643
16	Shannon-Weaver diversity index	0.961222	2.130308	1.623356

Organisms collected -

Ref. #				Taxon	# Riffle	# Vegetation	Total
7	^	…	Haplotaxida	Enchytraeidae	1		1
19			Haplotaxida	Limnodrilus		4	4
20			Haplotaxida	Tubifex		1	1
28			Amphipoda	Hyalella		2	2
48 *	^	…	Coleoptera	Agabus		1	1
54			Coleoptera	Dubiraphia		4	4

70	*	^	…	Coleoptera	Berosus		3	3
87				Diptera	Ceratopogonidae	2	1	3
90				Diptera	Chironomini	2	2	4
92				Diptera	Orthocladiinae	121	73	194
93				Diptera	Pseudochironomi	1		1
94				Diptera	Tanypodinae		2	2
95				Diptera	Tanytarsini		6	6
104				Diptera	Simulium	7	16	23
126.6				Ephemeroptera	Fallceon	10	5	15
131				Ephemeroptera	Caenis		2	2
228				Trichoptera	Cheumatopsyche		1	1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Summer
Stream name: Griever Creek
Date: 36041
Waterbody ID#: OK620920-01-0130G
Sample ID#: 20953

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	117	126	128	371
2	Number of taxa	13	18	16	27
3	Density/1 minute effort	1103.03	588	2389.333	1360.121
4	Modified Hilsenhoff biotic index	4.08547	5.992063	6.664063	5.622642
5	Modified North Carolina biotic index	5.655939	5.503937	6.311525	5.830502
6	Scrapers/scrapers + filtering collectors	0.012658	0.238095	0.833333	0.133005
7	Scrapers and filtering collectors/total	0.675214	0.083333	0.09375	0.273585
8	Shredders/total	0	0	0	0
9	Gathering collectors/total	0.205128	0.853175	0.671875	0.586253
10	Chironomidae/total	0.051282	0.555556	0.398438	0.342318

11			EPT/EPT + Chironomidae	0.806452	0.333333	0.392857	0.422727
12			EPT/EPT + Chronomini	1	0.583333	0.717391	0.709924
13			EPT/total	0.213675	0.277778	0.257813	0.250674
14			EPT taxa	4	3	4	7
15			Dominants/total	0.606838	0.285714	0.265625	0.218329
16			Shannon-Weaver diversity index	2.059143	3.028647	3.186101	3.523887

Organisms collected -

Ref. #					Taxon	# Riffle	# Woody	# Vegetation	Total
28				Amphipoda	Hyalella		1	1	2
43	*	^	…	Coleoptera	Chrysomelidae			1	1
54				Coleoptera	Dubiraphia		1	6	7
60				Coleoptera	Stenelmis	9	1		10
66	*	^	…	Coleoptera	Peltodytes			1	1
70	*	^	…	Coleoptera	Berosus			2	2
76	*	^	…	Coleoptera	Tropisternus	1			1
78.6	*	^	…	Coleoptera	Pronoterus			1	1
88.05				Diptera	Palpomyia		4		4
88.06				Diptera	Probezzia		1		1
88.07				Diptera	Stilobezzia			7	7
90				Diptera	Chironomini		25	13	38
92				Diptera	Orthocladiinae	1	1		2
93				Diptera	Pseudochironomi			1	1
94				Diptera	Tanypodinae	4	8	3	15
95				Diptera	Tanytarsini	1	36	34	71
95.7	*	^	…	Diptera	Dixa			1	1
124				Ephemeroptera	Callibaetis			1	1
126.6				Ephemeroptera	Fallceon	17	19	2	38
131				Ephemeroptera	Caenis		15	28	43
143				Ephemeroptera	Leptophlebiidae	1			1
159	*	^	…	Hemiptera	Rhagovelia		1		1

167	^	…	Megaloptera	Corydalus	3			3
179			Odonata	Argia	1	1	15	17
180			Odonata	Enallagma			5	5
184.1			Odonata	Arigomphus		1	3	4
186			Odonata	Erpetogomphus		1		1
187			Odonata	Gomphus	1			1
195			Odonata	Macromia		1		1
228			Trichoptera	Cheumatopsyche	71	8	2	81
229			Trichoptera	Hydropsyche	1			1
235			Trichoptera	Ithytrichia		1	2	3
247			Trichoptera	Chimarra	6			6
267			Basommatophora	Physella	1	1	5	7

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name: unnamed tributary to the South Canadian River
Date: 35856
Waterbody ID#: OKTemp-0003
Sample ID#: 20911

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	50	69	111	230
2	Number of taxa	10	11	17	24
3	Density/1 minute effort	1166.667	257.6	2072	1165.422
4	Modified Hilsenhoff biotic index	5.94	6.072464	5.576577	5.804348
5	Modified North Carolina biotic index	5.116714	4.906109	5.089078	5.040195
6	Scrapers/scrapers + filtering collectors	0	1	0.333333	0.181818
7	Scrapers and filtering collectors/total	0.12	0.007246	0.040541	0.047826
8	Shredders/total	0	0	0	0
9	Gathering collectors/total	0.81	0.963768	0.90991	0.904348
10	Chironomidae/total	0.74	0.855072	0.585586	0.7
11	EPT/EPT + Chironomidae	0.026316	0.032787	0.322917	0.174359

12			EPT/EPT + Chronomini	0.2	0.222222	0.861111	0.68	
13			EPT/total	0.02	0.028986	0.279279	0.147826	
14			EPT taxa	1	1	4	4	
15			Dominants/total	0.46	0.492754	0.27027	0.369565	
16			Shannon-Weaver diversity index	2.388437	2.364458	2.904476	2.953469	

Organisms collected -

Ref. #				Taxon	# Riffle	# Woody	# Vegetation	Total
7	^	…	Haplotaxida	Enchytraeidae		1	1	2
14			Haplotaxida	Nais	1	2	3	6
19			Haplotaxida	Limnodrilus	1			1
54			Coleoptera	Dubiraphia		1		1
58			Coleoptera	Microcylloepus		2		2
60			Coleoptera	Stenelmis	2	1	1	4
70 *	^	…	Coleoptera	Berosus		1		1
87			Diptera	Ceratopogonidae			3	3
90			Diptera	Chironomini	4	7	5	16
92			Diptera	Orthocladiinae	23	34	28	85
94			Diptera	Tanypodinae		5	2	7
95			Diptera	Tanytarsini	10	13	30	53
99			Diptera	Hemerodromia		1		1
104			Diptera	Simulium			2	2
110.5			Diptera	Chrysops	1			1
116			Diptera	Gonomyia			2	2
126.6			Ephemeroptera	Fallceon	1	2	25	28
131			Ephemeroptera	Caenis			3	3
145			Ephemeroptera	Leptophlebia			2	2
179			Odonata	Argia			1	1
191			Odonata	Progomphus	1			1
228			Trichoptera	Cheumatopsyche			1	1
234			Trichoptera	Hydroptila			1	1

266	Basommatophora	Physa			1	1
275	Veneroida	Corbicula	6			6

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name: unnamed tributary to the South Canadian River
Date: 36040
Waterbody ID#: OKTemp-0003
Sample ID#: 20950

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	150	113	108	371
2	Number of taxa	6	21	19	24
3	Density/1 minute effort	7000	#DIV/0!	586.0465	3793.023
4	Modified Hilsenhoff biotic index	5.013333	5.876106	5.240741	5.342318
5	Modified North Carolina biotic index	6.115066	5.530376	5.650274	5.801677
6	Scrapers/scrapers + filtering collectors	0	0.103448	0.296296	0.054726
7	Scrapers and filtering collectors/total	0.966667	0.256637	0.25	0.541779
8	Shredders/total	0	0.00885	0.018519	0.008086
9	Gathering collectors/total	0.02	0.588496	0.361111	0.292453
10	Chironomidae/total	0.013333	0.451327	0.25	0.215633
11	EPT/EPT + Chironomidae	0	0.238806	0.325	0.266055
12	EPT/EPT + Chronomini	#DIV/0!	0.421053	0.65	0.5
13	EPT/total	0	0.141593	0.12037	0.078167
14	EPT taxa	0	5	5	6
15	Dominants/total	0.966667	0.20354	0.231481	0.447439
16	Shannon-Weaver diversity index	0.28824	3.547806	3.703134	3.065096

Organisms collected -

Ref. #				Taxon	# Riffle	# Woody	# Vegetation	Total
19			Haplotaxida	Limnodrilus	1			1
45			Coleoptera	Helichus		1	2	3
55			Coleoptera	Heterelmis		2	1	3
57			Coleoptera	Macronychus		3		3
58			Coleoptera	Microcylloepus		2	5	7
60			Coleoptera	Stenelmis	1	8	25	34
83 *	^	…	Coleoptera	Scirtes			1	1
83.2 *	^	…	Coleoptera	Staphylinidae			1	1
88.05			Diptera	Palpomyia		1		1
90			Diptera	Chironomini		22	7	29
94			Diptera	Tanypodinae	1	6	11	18
95			Diptera	Tanytarsini	1	23	9	33
95.7 *	^	…	Diptera	Dixa			1	1
117			Diptera	Hexatoma		1		1
126.6			Ephemeroptera	Fallceon		1	3	4
131			Ephemeroptera	Caenis		10	3	13
141			Ephemeroptera	Stenacron		1	1	2
142.4			Ephemeroptera	Isonychia		3	3	6
167	^	…	Megaloptera	Corydalus		1	1	2
179			Odonata	Argia		1	4	5
186			Odonata	Erpetogomphus	1	1	1	3
191			Odonata	Progomphus			5	5
228			Trichoptera	Cheumatopsyche		13	4	17
238			Trichoptera	Nectopsyche			3	3
250			Trichoptera	Cyrnellus		1		1
267			Basommatophora	Physella		3	8	11
275			Veneroida	Corbicula	145	9	12	166

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name: Otter Creek

Date:	36559
Waterbody ID#:	OK620910-03-0040G
Sample ID#:	18381

Metric #	Description	Riffle
1	Number of organisms	107
2	Number of taxa	9
3	Density/1 minute effort	1630.476
4	Modified Hilsenhoff biotic index	6.149533
5	Modified North Carolina biotic index	5.081163
6	Scrapers/scrapers + filtering collectors	0
7	Scrapers and filtering collectors/total	0.420561
8	Shredders/total	0
9	Gathering collectors/total	0.570093
10	Chironomidae/total	0.523364
11	EPT/EPT + Chironomidae	0.034483
12	EPT/EPT + Chronomini	0.285714
13	EPT/total	0.018692
14	EPT taxa	1
15	Dominants/total	0.439252
16	Shannon-Weaver diversity index	1.808675

Organisms collected -

Ref. #		Taxon	# Riffle
18.2	Haplotaxida	Branchiura	1
19	Haplotaxida	Limnodrilus	2
90	Diptera	Chironomini	5
92	Diptera	Orthocladiinae	47
94	Diptera	Tanypodinae	2
95	Diptera	Tanytarsini	2
104	Diptera	Simulium	45

126.6	Ephemeroptera	Fallceon	2
285.5	Tricladida	Dugesia	1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name: Otter Creek
Date: 36927
Waterbody ID#: OK620910-03-0040G
Sample ID#: 22426

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	296	230	227	753
2	Number of taxa	19	15	10	26
3	Density/1 minute effort	2046.42	858.6667	302.6667	1069.251
4	Modified Hilsenhoff biotic index	5.709459	6.095652	6.1875	5.970667
5	Modified North Carolina biotic index	5.478801	4.941915	5.228909	5.239522
6	Scrapers/scrapers + filtering collectors	0.054545	0	0	0.034483
7	Scrapers and filtering collectors/total	0.185811	0.052174	0.089286	0.116
8	Shredders/total	0	0.008696	0	0.002667
9	Gathering collectors/total	0.662162	0.913043	0.883929	0.805333
10	Chironomidae/total	0.206081	0.4	0.325991	0.301461
11	EPT/EPT + Chironomidae	0.344086	0.132075	0.267327	0.243333
12	EPT/EPT + Chronomini	0.888889	0.5	0.931034	0.784946
13	EPT/total	0.108108	0.06087	0.118943	0.096946
14	EPT taxa	5	5	3	8
15	Dominants/total	0.5	0.5	0.506608	0.501992
16	Shannon-Weaver diversity index	2.721358	2.028528	1.821308	2.419979

Organisms collected -

Ref. #				Taxon	# Riffle	# Woody	# Vegetation	Total
19			Haplotaxida	Limnodrilus	13			13
28			Amphipoda	Hyalella			1	1
45			Coleoptera	Helichus		1		1
60			Coleoptera	Stenelmis	15			15
71 *	^	…	Coleoptera	Enochrus			2	2
88.2 *	^	…	Diptera	Chaoborus			1	1
90			Diptera	Chironomini	4	14	2	20
92			Diptera	Orthocladiinae	45	73	71	189
93			Diptera	Pseudochironomi	5			5
94			Diptera	Tanypodinae	7	3	1	11
95			Diptera	Tanytarsini		2		2
104			Diptera	Simulium	12	4	9	25
111			Diptera	Tabanus	5			5
122.7			Ephemeroptera	Acerpenna			3	3
126.6			Ephemeroptera	Fallceon		1		1
131			Ephemeroptera	Caenis	9	8	23	40
142			Ephemeroptera	Stenonema		1		1
146			Ephemeroptera	Neochoroterpes	11	3	1	15
151			Ephemeroptera	Tricorythodes	4	1		5
167	^	…	Megaloptera	Corydalus	1			1
179			Odonata	Argia	1	1		2
186			Odonata	Erpetogomphus		1		1
228			Trichoptera	Cheumatopsyche	6	2		8
234			Trichoptera	Hydroptila	1			1
247			Trichoptera	Chimarra	7			7
267			Basommatophora	Physella	1			1
279			Veneroida	Sphaerium	1		1	2

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name: Otter Creek
Date: 36726
Waterbody ID#: OK620910-03-0040G
Sample ID#: 21556

Metric #	Description	Riffle	Woody	Vegetation	Pooled
1	Number of organisms	218	215	220	653
2	Number of taxa	18	13	13	25
3	Density/1 minute effort	1162.667	344	1368.889	958.5185
4	Modified Hilsenhoff biotic index	4.53211	6.11215	5.472727	5.368098
5	Modified North Carolina biotic index	4.852205	5.35869	5.504826	5.238653
6	Scrapers/scrapers + filtering collectors	0.041096	0	0	0.02439
7	Scrapers and filtering collectors/total	0.669725	0.093458	0.363636	0.377301
8	Shredders/total	0	0	0	0
9	Gathering collectors/total	0.298165	0.859813	0.618182	0.590491
10	Chironomidae/total	0.100917	0.413953	0.295455	0.269525
11	EPT/EPT + Chironomidae	0.666667	0.053191	0.144737	0.254237
12	EPT/EPT + Chronomini	0.88	0.2	0.478261	0.612245
13	EPT/total	0.201835	0.023256	0.05	0.091884
14	EPT taxa	9	4	3	11
15	Dominants/total	0.5	0.502326	0.5	0.500766
16	Shannon-Weaver diversity index	2.626876	2.312929	2.28726	2.605852

Organisms collected -

Ref. #				Taxon	# Riffle	# Woody	# Vegetation	Total
28			Amphipoda	Hyalella			2	2
55			Coleoptera	Heterelmis			1	1
63 *	^	…	Coleoptera	Gyretes		1		1
90			Diptera	Chironomini	6	20	12	38
92			Diptera	Orthocladiinae	2	12	10	24
94			Diptera	Tanypodinae	10	39	40	89

95			Diptera	Tanytarsini	4	18	3	25
104			Diptera	Simulium	5	1		6
123			Ephemeroptera	Baetis	2			2
126.6			Ephemeroptera	Fallceon	3	1		4
131			Ephemeroptera	Caenis		1		1
139			Ephemeroptera	Leucrocuta	5			5
142.4			Ephemeroptera	Isonychia	3		1	4
143			Ephemeroptera	Leptophlebiidae	1			1
151			Ephemeroptera	Tricorythodes		1		1
166			Megaloptera	Corydalidae			1	1
167	^	…	Megaloptera	Corydalus	2	2		4
177			Odonata	Hetaerina		3		3
178			Odonata	Coenagrionidae			1	1
179			Odonata	Argia	1			1
228			Trichoptera	Cheumatopsyche	35	7	29	71
229			Trichoptera	Hydropsyche	7	2	2	11
234			Trichoptera	Hydroptila	1			1
235.5			Trichoptera	Ochrotrichia	2			2
247			Trichoptera	Chimarra	20		8	28

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Red Rock Creek
Date:	36047
Waterbody ID#:	OK621200-05-0010K
Sample ID#:	20956

Metric #	Description	Riffle	Woody	Pooled
1	Number of organisms	101	138	239
2	Number of taxa	11	11	13
3	Density/1 minute effort	15082.67	686.9333	7884.8
4	Modified Hilsenhoff biotic index	4.574257	6.101449	5.456067

5			Modified North Carolina biotic index	5.50622	5.642788	5.585075
6			Scrapers/scrapers + filtering collectors	0	0	0
7			Scrapers and filtering collectors/total	0.663366	0.362319	0.48954
8			Shredders/total	0	0	0
9			Gathering collectors/total	0.227723	0.597826	0.441423
10			Chironomidae/total	0.168317	0.572464	0.401674
11			EPT/EPT + Chironomidae	0.514286	0.131868	0.238095
12			EPT/EPT + Chronomini	0.666667	0.155844	0.288462
13			EPT/total	0.178218	0.086957	0.125523
14			EPT taxa	4	4	4
15			Dominants/total	0.534653	0.471014	0.39749
16			Shannon-Weaver diversity index	2.270255	2.117387	2.344377

Organisms collected -

Ref. #				Taxon	# Riffle	# Woody	Total
18.2			Haplotaxida	Branchiura	1		1
60			Coleoptera	Stenelmis	10	5	15
87.5			Diptera	Atrichopogon		1	1
90			Diptera	Chironomini	9	65	74
92			Diptera	Orthocladiinae		1	1
94			Diptera	Tanypodinae	7	11	18
95			Diptera	Tanytarsini	1	2	3
123			Ephemeroptera	Baetis	1	1	2
151			Ephemeroptera	Tricorythodes	4	2	6
167	^	…	Megaloptera	Corydalus	1		1
228			Trichoptera	Cheumatopsyche	54	41	95
229			Trichoptera	Hydropsyche	1	1	2
230			Trichoptera	Potamyia	12	8	20

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Sandy Creek
Date:	36586
Waterbody ID#:	OK621010-02-0010G
Sample ID#:	18391

Metric #	Description	Woody
1	Number of organisms	124
2	Number of taxa	19
3	Density/1 minute effort	330.6667
4	Modified Hilsenhoff biotic index	5.491935
5	Modified North Carolina biotic index	5.005438
6	Scrapers/scrapers + filtering collectors	0
7	Scrapers and filtering collectors/total	0.072581
8	Shredders/total	0
9	Gathering collectors/total	0.737903
10	Chironomidae/total	0.637097
11	EPT/EPT + Chironomidae	0.177083
12	EPT/EPT + Chronomini	0.809524
13	EPT/total	0.137097
14	EPT taxa	6
15	Dominants/total	0.467742
16	Shannon-Weaver diversity index	2.972221

Organisms collected -

Ref. #			Taxon	# Woody
10	…	Lumbriculida	Lumbriculidae	2
14		Haplotaxida	Nais	2
19		Haplotaxida	Limnodrilus	2
87.6		Diptera	Bezzia	1
90		Diptera	Chironomini	4

92	Diptera	Orthocladiinae	58
93	Diptera	Pseudochironomi	2
94	Diptera	Tanypodinae	10
95	Diptera	Tanytarsini	5
99.5	Diptera	Ephydridae	1
104	Diptera	Simulium	8
117.5	Diptera	Limnophila	11
122.5	Ephemeroptera	Acentrella	2
126.6	Ephemeroptera	Fallceon	2
131	Ephemeroptera	Caenis	1
141	Ephemeroptera	Stenacron	6
142	Ephemeroptera	Stenonema	1
214	Plecoptera	Perlesta	5
228	Trichoptera	Cheumatopsyche	1

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Sandy Creek
Date:	36727
Waterbody ID#:	OK621010-02-0010G
Sample ID#:	21565

Metric #	Description	Woody
1	Number of organisms	97
2	Number of taxa	15
3	Density/1 minute effort	91.29412
4	Modified Hilsenhoff biotic index	6.063158
5	Modified North Carolina biotic index	5.064139
6	Scrapers/scrapers + filtering collectors	0.028571
7	Scrapers and filtering collectors/total	0.360825
8	Shredders/total	0

9	Gathering collectors/total	0.597938
10	Chironomidae/total	0.453608
11	EPT/EPT + Chironomidae	0.505618
12	EPT/EPT + Chronomini	0.529412
13	EPT/total	0.463918
14	EPT taxa	6
15	Dominants/total	0.412371
16	Shannon-Weaver diversity index	2.681588

Organisms collected -

Ref. #				Taxon	# Woody
55			Coleoptera	Heterelmis	1
71	*	^	…	Coleoptera	Enochrus	1
88.06				Diptera	Probezzia	1
90				Diptera	Chironomini	40
94				Diptera	Tanypodinae	4
99				Diptera	Hemerodromia	1
104				Diptera	Simulium	1
120.55				Ephemeroptera		2
126.6				Ephemeroptera	Fallceon	6
139				Ephemeroptera	Leucrocuta	2
142.4				Ephemeroptera	Isonychia	7
151				Ephemeroptera	Tricorythodes	4
167		^	…	Megaloptera	Corydalus	1
177				Odonata	Hetaerina	1
228				Trichoptera	Cheumatopsyche	2
229				Trichoptera	Hydropsyche	24

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Stream name:	Sandy Creek
Date:	37095
Waterbody ID#:	OK621010-02-0010G
Sample ID#:	23319

Metric #	Description	Woody
1	Number of organisms	109
2	Number of taxa	20
3	Density/1 minute effort	152.6
4	Modified Hilsenhoff biotic index	5.009174
5	Modified North Carolina biotic index	4.547992
6	Scrapers/scrapers + filtering collectors	0
7	Scrapers and filtering collectors/total	0.275229
8	Shredders/total	0.055046
9	Gathering collectors/total	0.275229
10	Chironomidae/total	0.091743
11	EPT/EPT + Chironomidae	0.87013
12	EPT/EPT + Chronomini	0.905405
13	EPT/total	0.614679
14	EPT taxa	10
15	Dominants/total	0.155963
16	Shannon-Weaver diversity index	3.832238

Organisms collected -

Ref. #				Taxon	# Woody
45			Coleoptera	Helichus	6
57			Coleoptera	Macronychus	3
60			Coleoptera	Stenelmis	6
67.5 *	^	…	Coleoptera	Hydraena	1
72 *	^	…	Coleoptera	Helophorus	1

73	*	^	…	Coleoptera	Hydrochus	1
83	*	^	…	Coleoptera	Scirtes	1
90				Diptera	Chironomini	7
94				Diptera	Tanypodinae	1
95				Diptera	Tanytarsini	2
126.6				Ephemeroptera	Fallceon	5
130.1				Ephemeroptera	Brachycercus	2
131				Ephemeroptera	Caenis	5
138				Ephemeroptera	Heptagenia	3
141				Ephemeroptera	Stenacron	1
142				Ephemeroptera	Stenonema	11
142.4				Ephemeroptera	Isonychia	17
151				Ephemeroptera	Tricorythodes	8
167		^	…	Megaloptera	Corydalus	14
177				Odonata	Hetaerina	1
191				Odonata	Progomphus	1
228				Trichoptera	Cheumatopsyche	1
229				Trichoptera	Hydropsyche	12
238				Trichoptera	Nectopsyche	3

* - taxon excluded from all metric calculations
^ - taxon excluded from Hilsenhoff biotic index
… - taxon excluded from North Carolina biotic index

Reference Totals

Turkey Lower-Turkey Middle-Buffalo Creek	Winter			Summer	
	Riffle	Woody	Vegetation	Riffle	Woody
Number of taxa	6	6	6	6	6
Modified Hilsenhoff biotic index	6	6	6	6	6
EPT/EPT + Chronomini	6	6	6	6	6
EPT/total	0	2	2	2	4
EPT taxa	6	6	6	6	6
Dominants/total	0	0	0	0	2

Shannon-Weaver diversity index	2	4	2	2	4	
	26	30	28	28	34	

Turkey Upper-Clear Creek-Little Turkey	Winter Riffle	Woody	Vegetation	Summer Riffle	Woody	Vegetation
Number of taxa	6	6	6	6	6	6
Modified Hilsenhoff biotic index	6	6	6	6	6	6
EPT/EPT + Chronomini	6	6	6	6	6	6
EPT/total	0	0	0	2	4	2
EPT taxa	6	6	6	6	6	6
Dominants/total	0	0	0	0	4	4
Shannon-Weaver diversity index	2	2	4	0	4	4
Score	26	26	28	26	36	34

	Buffalo Winter Riffle	Winter Woody	Winter Vegetation
Number of taxa	4	6	6
Modified Hilsenhoff biotic index	6	6	6
EPT/EPT + Chronomini	6	6	6
EPT/total	0	0	0
EPT taxa	0	2	0
Dominants/total	2	0	0
Shannon-Weaver diversity index	4	2	2
Score	22	22	20
% of reference	84.61538	84.61538	71.42857

	Clear Winter Riffle	Winter Woody	Winter Vegetation	Clear Summer Riffle	Summer Vegetation
Number of taxa	6	6	4	6	4
Modified Hilsenhoff biotic index	6	6	6	4	6
EPT/EPT + Chronomini	6	6	6	6	6

EPT/total	2	2	4	4	4
EPT taxa	6	6	6	6	0
Dominants/total	0	0	4	2	4
Shannon-Weaver diversity index	2	2	4	4	4
Score	28	28	34	32	28
% of reference	107.6923	107.6923	121.4286	123.0769	82.35294

	Little Turkey Winter Riffle	Little Turkey Winter Woody	Little Turkey Winter Vegetation	Little Turkey Summer Score Woody
Number of taxa	6	6	6	4
Modified Hilsenhoff biotic index	6	6	6	6
EPT/EPT + Chronomini	6	6	6	6
EPT/total	2	4	6	6
EPT taxa	6	6	6	6
Dominants/total	0	0	0	6
Shannon-Weaver diversity index	2	2	4	4
Score	28	30	34	38
% of reference	107.6923	115.3846	121.4286	105.5556

	Turkey Lower Winter Riffle	Turkey Lower Winter Woody	Turkey Lower Summer Score Woody
Number of taxa	2	4	2
Modified Hilsenhoff biotic index	6	6	4
EPT/EPT + Chronomini	6	2	0
EPT/total	0	0	0
EPT taxa	0	2	0
Dominants/total	0	0	0
Shannon-Weaver diversity index	2	2	0
Score	16	16	6
% of reference	61.53846	53.33333	17.64706

	Turkey Middle Winter Score	
	Woody	Vegetation
Number of taxa	4	6
Modified Hilsenhoff biotic index	6	6
EPT/EPT + Chronomini	6	6
EPT/total	2	6
EPT taxa	6	6
Dominants/total	0	2
Shannon-Weaver diversity index	2	4
Score	26	36
% of reference	86.66667	128.5714

	Turkey Middle Summer Score
	Woody
Number of taxa	6
Modified Hilsenhoff biotic index	6
EPT/EPT + Chronomini	6
EPT/total	4
EPT taxa	6
Dominants/total	0
Shannon-Weaver diversity index	2
Score	30
% of reference	88.23529

	Turkey Upper Winter Score		
	Riffle	Woody	Vegetation
Number of taxa	6	6	4
Modified Hilsenhoff biotic index	6	6	6
EPT/EPT + Chronomini	6	6	4
EPT/total	0	2	0
EPT taxa	6	6	6
Dominants/total	2	2	0
Shannon-Weaver diversity index	4	2	2
Score	30	30	22
% of reference	115.3846	115.3846	78.57143

	Turkey Upper Summer Score		
	Riffle	Woody	Vegetation
Number of taxa	6	6	4
Modified Hilsenhoff biotic index	4	6	4
EPT/EPT + Chronomini	6	2	0
EPT/total	0	2	2
EPT taxa	6	6	2
Dominants/total	2	0	0
Shannon-Weaver diversity index	4	2	2
Score	28	24	14
% of reference	107.6923	66.66667	41.17647

APPENDIX F:

Watershed Implementation Plan

POLICIES AND APPROVED CONSERVATION PRACTICES FOR UPPER LITTLE TURKEY CREEK 319 NON POINT POLLUTION COST-SHARE

FY 1996 319(h) Task 700
C9-996100-04-0
Turkey Creek Demonstration Watershed Project

Beginning August 1, 2002
Ending September 30, 2003

Developed by:

Oklahoma Conservation Commission

in cooperation with:

Kingfisher County Conservation District

OKLAHOMA CONSERVATION COMMISSION

STATE GUIDELINES FOR THE UPPER LITTLE TURKEY CREEK 319 NON POINT DEMONSTRATION COST-SHARE PROGRAM

PROGRAM DIRECTIVES AND APPROVED PRACTICES

I. GENERAL

The Oklahoma Conservation Commission recognizes that the following problems are having a detrimental affect on the state's water resources in the Upper Little Turkey Creek Watershed: (1) nutrient and sediment loading, (2) lack of buffer zones.

The Conservation Commission herein presents the complete list and description of the Conservation Cost-Share Program policies and conservation practices recommended and approved by the Kingfisher County Conservation District for use during this program (see Section II for the approved list of conservation practices). Cost-share rates (unit cost) are based on the Oklahoma Natural Resources Conservation Service (NRCS) unit cost, effective date January 1, 2002. When a project agreement (contract) has been developed with an applicant, the same unit cost will be in force for the life of the agreement. Any variances in the best management practices must be recommended by, and approved by, the Kingfisher County Conservation District, and approved by the Oklahoma Conservation Commission – Water Quality Division. These variances must be approved prior to performance agreements being signed.

Kingfisher County Conservation District has been allocated $60,000.00 for implementation of best management practices in this demonstration project. The cost share percentage will be 75% EPA funds ($60,000.00) with the cooperator paying 25% as a match for the EPA funds.

Policies

The best management practices (see Section II) that will be offered to residents in the Upper Little Turkey Creek have been recommended and approved by the Kingfisher County Conservation District board and ultimately approved by the Oklahoma Conservation Commission – Water Quality Division.

Cost-share best management practices will be implemented according to NRCS standards and specifications.

Conservation Commissioners, Conservation Commission staff, conservation district employees or the spouses of any of these people shall not be eligible to participate in the Conservation Cost-Share Program.

Conservation district directors and members of the Watershed Advisory Group are eligible to participate in the Upper Little Turkey Creek Cost-Share Program. If district directors choose to participate, the following OCC policy will apply:
In order to provide for an impartial legal majority, it shall be the policy of the Oklahoma Conservation Commission that no more than two district directors from Kingfisher County shall participate in the cost share program. Furthermore, the directors who desire to apply for the cost share program shall refrain from discussing or voting on any items or issues pertaining to the cost share program, including rates, practices, maximum payment and applicants for the program.

The Oklahoma Conservation Commission water quality staff, with concurrence of the Kingfisher County Conservation District, has developed special forms for:(1) Upper Little Turkey Creek Project Cost-Share Assistance Application Form; (2) Project Priority Ranking System; (3) Schedule of Operations Form; (4) Performance Agreement; (5) Consent Form (if cooperator is not owner of property); (6) Maintenance Agreement; (7) Summary of Applicants; (8) Cost Share Payment Calculation Sheet; (9) Certification of Completion; (10) Release of Warrant; (11) Cancellation of Performance Agreement and; (12) Schedule of Operations Revision Form (see attached forms).

The Oklahoma Conservation Commission State Guidelines for Conservation Cost Share Program shall be followed in the implementation of this project.

Eligibility Criteria

To participate in this program, one must meet the following criteria: (1) own or operate land in the Upper Little Turkey Creek Watershed described as follows: all the acreage of Little Turkey Creek Watershed that is in Sections 18, 19, 20, 21, 28, 29, 30, 31 & 32 of Township 19 North, Range 6 West will be Priority #1. If funds are available the acreage in Township North, Range 7 West may be included; (2) have a need for a best management practice that is in the program that addresses a water quality issue; (3) the applicant will be required to maintain the BMP for the determined life of the practice; (4) be a cooperator with the Kingfisher County Conservation District.

II. LIST OF APPROVED CONSERVATION PRACTICES FOR THE UPPER LITTLE TURKEY CREEK 319 NON-POINT PROGRAM

The following is a list of Best Management Practices (BMP) and component parts for each BMP that has been approved for implementation in the Upper Little Turkey Creek Demonstration Area. The Kingfisher County Conservation District approved the BMP list at their regularly scheduled meeting on August 14, 2002.

NRCS Practice Code	Practice Name/Component	Units	Cost Share	Cost
512	**PASTURE & HAYLAND PLANTING**			
	Bermuda grass	Ac.	75%	$45.00
	Jose' tall wheat grass	#PLS	75%	$1.50/lbPLS
	Pubescent wheat grass	#PLS	75%	$2.45/lbPLS
	Tractor and drill cost	Ac.	75%	$10.00/ac.
	Seedbed preparation (farm equip)	Ac.	75%	$20.00/ac.
	Fertilizer (according to soil test)			.
	Nitrogen	Lbs.	75%	$ .30
	Phosphorus	Lbs.	75%	$ .26
	Potash	Lbs.	75%	$ .15
550	**NATIVE MIXTURE WITH LEGUMES**			
	Native mixture with legumes	Lbs/PLS	75%	$11.00
382	**FENCE**			
	Four Wire Permanent (filter strip)	L. ft.	75%	$ .90/Lft.
342	**CRITICAL AREA PLANTING**			
	Shaping and filling gullies	Ac.	75%	$400.00/ac.
378	**POND**			
	Pond	Cu. yds.	75%	$1.02/cu yd.
516	**WATER LINES – PVC**			
	PVC	DIFT	75%	$ .68 DIFT
614	**FREEZE-PROOF TANKS**			
	Freeze-proof tanks	Each	75%	$800.00

III. CONSERVATION COST-SHARE PRACTICE STANDARDS AND SPECIFICATIONS

See Natural Resources Conservation Service Standards and Specifications and Department of Environmental Quality Bulletin 640.

Cost share rates and per unit costs are in compliance with the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) Cost List dated January 1, 2002.

IV. SEQUENCE OF EVENTS FOR IMPLEMENTATION OF BEST MANAGEMENT PRACTICES (BMP)

When the BMP List has been approved by the Kingfisher County Conservation District board, with concurrence of the OCC Water Quality staff, the following sequence of events will be initiated:

(1) Signup
(2) Priority Ranking
(3) Plan Development to include:
    a) Conservation Plan (to include BMP's)
    b) Schedule of Operations
    c) Performance Agreement
    d) Maintenance Agreement
(4) The conservation plan and the performance agreement must be approved by the Kingfisher County Conservation District and a representative of the OCC Water Quality staff.
(5) After the above approval is obtained, the cooperator can begin installation of the BMP's as stated in the plan and as scheduled on the Schedule of Operation.
(6) After the cooperator has completed a BMP, the practice must be certified as completed by a representative of the Kingfisher County Conservation District.
(7) The cooperator will be required to furnish the Kingfisher County Conservation District all receipts for materials and labor for the installation of the BMP, to include his/her in-kind labor or materials that they may have supplied.

Three (3) copies of the plan will be assembled in a six (6)-part folder. One copy will be for the cooperator, one for the district office and one for the Oklahoma Conservation Commission Water Quality Division.

V. PAYMENT OF INSTALLED BEST MANAGEMENT PRACTICES

The same procedure as the State Cost Share Program will be used. Reference the OCC Rules/Guidelines Summary (dated 10/01) sub-paragraph titled ***Submitting a Cost Share Payment***

UPPER LITTLE TURKEY CREEK WATERSHED
CONSERVATION COST-SHARE PROGRAM
COST-SHARE APPLICATION

Conservation District

Name			
Address	City	State	Zip
Phone Number			
Social Security Number or Federal Employee Identification Number (Successful applicants will receive an IRS Form 1099 for payment received.)			
Legal description where the conservation practice(s) is to be installed.		County	
Do you own, lease, or rent this land? ____ Own ____ Lease ____ Rent If not the landowner, provide a properly executed consent form from the owner(s) of the land and file it with the application.			
For which conservation practice(s) are you applying?			

To participate in the Upper Little Turkey Creek Cost Share Program, the applicant must have a need for at least one of the BMP's and will be required to install, with cost share assistance, all of the needed BMP's as offered in the program. The needs will be determined by the conservation planner representing the local conservation district and in cooperation with the participant.

By signing this form I am asking the Kingfisher County Conservation District to develop a conservation plan, cost estimate and amount of cost share assistance available on the above acreage.

I understand this application does not obligate the applicant or the Conservation District to enter into a contract. I am not an Oklahoma Conservation Commission commissioner or employee, conservation district employee or the spouse of any of these people mentioned above. To the best of my knowledge, the information on this application is correct.

Applicant
Signature_____Date_____
319 Planner
Signature_____Title_____Date_____

Failure to provide correct, complete information will result in the withholding or withdrawal of financial assistance.

Upper Little Turkey Creek Watershed
Cost Share Program
Priority Ranking System Form

Name:_____ Address:_____

Telephone:_____ _____

Acreage:_____

Buffer Establishment:
Pasture & Hayland Planting 20 points/ac_____
OR
Native Mixture with Legumes

Critical Area 20 points/ac_____

Pond for Sediment Control 10 points_____

Pipeline and/or Freeze Proof Tank 10 points_____

TOTAL POINTS _____

This form will be used to determine priorities for planning and funds distribution. The applicants with the highest number of points, as determined by the planner, will be the first priority for planning and fund allocations.

UPPER LITTLE TURKEY CREEK DEMONSTRATION COST SHARE PROGRAM

SCHEDULE OF OPERATIONS

Name				**County**	**State OK**	**Agreement No.**			**Total Acres Under Contract**				
									Completion Schedule and Estimated Cost Share By Year (For Noncost Share Items Show Units)				
Item No.	Field	Code	Planned Conservation Treatment (Record of Decisions)	Units	Cost Basis	Total Cost	Cost Share %	Total Cost Share Amount	Year	Year	Year	Year	Year
Total Cost Shared Amounts													

UPPER LITTLE TURKEY CREEK
CONSERVATION COST-SHARE PROGRAM
PERFORMANCE AGREEMENT

This agreement, made and entered into by and between the _____ Conservation District, hereinafter referred to as District, and _____ herein after referred to as participant.

Part I – Conservation Practice(s) To Be Completed
See attached Schedule for the conservation practice(s) to be implemented as set forth in the participant's Conservation Plan.

Part II – Stipulations

1. The participant agrees:
    1. To perform or have performed all work described in Part I in accordance with specifications furnished by the District or the Natural Resources Conservation Service (NRCS).
    2. To submit to the District a "Claim Affidavit" and detailed, itemized statement of costs and copies of contractor's invoices when practice(s) are installed by a contractor.
    3. To submit to the District detailed invoices for participant in-kind contributions.
    4. To complete or have completed all work described in Part I as scheduled.
    5. To obtain required permits and approvals prior to the construction of the conservation practice(s).
    6. To permit free access to the participant's land for District and NRCS representatives to inspect the practice(s) upon completion.
    7. To maintain the practice(s) as outlined in the cost-share Maintenance Agreement for the specified life of the practice(s) at no cost to the District.
    8. To accept the District's method of calculating the cost-share payment(s) for completed work.
2. The District agrees:
    1. To provide assistance to the participant to develop a new or revised Conservation Plan that reflects the practice(s) outlined in Part I.
    2. To provide specifications and technical assistance for work described in Part I.
    3. To provide and pay a cost-share level, as shown on attached Schedule, or the lesser of the established District average cost or actual cost to install the practice(s). Cost share reimbursement will not exceed $_____.
    4. To accept in-kind contributions from the participant for work performed by the participant on approved cost-share practice(s) installed.

Part III – Payment Stipulations
In order for participant to receive yearly incentive payments, all other practices must be installed/implemented and maintained according to the Schedule of Operations unless a contract change is made and approved by the District and OCC Representative.
Part IV - Compliance

It is mutually understood that if the cooperator is determined to be in non-compliance during the annual status review, the district board has the discretion to pull funds. The cooperator will be notified of this action by letter.

Part V – Signatures

This agreement shall be effective from the last date of signature below. Work cannot begin until an effective agreement is in place.

_____Date_____
Participant Signature

_____
Social Security Number or
Federal Employee Identification Number

_____Date_____
Conservation Planner Signature

_____Date_____
Chairman-Conservation District

_____Date_____
OCC Water Quality Representative

UPPER LITTLE TURKEY CREEK WATERSHED DEMONSTRATION COST-SHARE PROGRAM

CONSENT

OWNER'S NAME			
Owner's Address	City	State	Zip
Owner's Phone Number			
Legal description where the practice(s) is to be installed.			
Applicant's Name			

I/we, owner of the property listed above, do hereby grant the property lessee the right to enter into the Conservation Cost-Share Program for_____ conservation practice(s).

I agree to pay the difference not covered by the Conservation Cost-Share Program.

The lessee agrees to pay the difference not covered by the Conservation Cost-Share Program.

_____ _____
Land Owner Applicant

_____ _____
Witness Witness

_____ _____
Date Date

UPPER LITTLE TURKEY CREEK WATERSHED DEMONSTRATION COST-SHARE PROGRAM

MAINTENANCE AGREEMENT

It is hereby recognized and agreed that the construction of the following conservation practice(s) will be maintained as designed and constructed for the listed amount of time. The undersigned participant hereby assumes all responsibility for maintenance of the treated areas in a manner in which will serve the above purpose. The participant will protect the installed conservation practice from damage and make minor repairs as necessary. Should the participant choose to remove or destroy the conservation practice before the end of its life span, the participant will be expected to repay a prorated amount of the cost-share back to the conservation district. Destruction of a conservation practice(s) by an act of nature is exempt from this provision. The participant also agrees to permit free access to the participants land for District and NRCS representatives to inspect maintenance of the conservation practice(s) for the life span of the conservation practice(s). The _____ Conservation District agrees to make available the needed technical assistance to assist the participant in making sound maintenance decisions.

Practice	Life of Practice

_____ Date_____
Participant Signature

APPENDIX G:

Project Manager's Journal of Activities

JOURNAL

TURKEY CREEK

00-05-31 Phone Call Roger Gribble- OSU Extension

- Called Roger to see about the possibility of finding producers to use ash in the watershed
- He said it might be difficult to find 25 producers, need to stick to a realistic number—10?
- We can apply at a rate of 2 – 3 tons per acre so 320 to 480 tons per 160 acres for a total of 3200 or 4800 tons
- Wants to look at the Turkey Creek data that Chris Hise has maybe on the 20th or 21st of June

00-06-01 Phone Call Steve Winter [redacted]

- Steve said he found some producers that will be interested in the working in the watershed.
  - [redacted] north part of watershed; Ex Director of the OK Grain Association
  - [redacted] north part of watershed
  - [redacted] south end of watershed
- There are two grain elevators in the watershed that are Farmland; they may not haul to the Port

00-06-01 Phone Call Dennis [redacted]

- Called to see if they would be interested in looking at the possibility of using ash
- He said they are interested, but have to wait until the end of harvest.
- I asked if there would be someone on his end to visit with—he said they will work out something
- I will call on the 19th or 26th.

00-06-14 Phone Call Ken [redacted]

- I called him to ask for his help in contacting the Red Rock ash for the ECBC grant and perhaps set up a contact
- He spoke with Evans and Associates and they are interested and will be calling me. Someone named Linda or Julie not sure which.

00-06-21 Phone Call Linda [redacted] **(Evans & Associates)**

- Discussed the background information for the project.
- Interested in meeting with me to discuss the possibility of finding alternative uses for some of their non-spec ash.
- She sent a sample of the three types of ash they generate

00-06-21 Meeting with OSU Extension

Gordon Johnson, Kevin Ron Robinson Roger Gribble
Phil Moershel Scott Stoodley Chris Hise Geoff

SUMMARY

- Chris gave his Turkey presentation. Gordon found the P in the high flow and ground water to be puzzling.

- The OSU folks believe they have N and P application rate on crops down to the point that it is not affecting WQ. They feel animal waste may be more important avenue to pursue or perhaps looking at P movement on the loss of soil from fields.
- Roger would like to stick with agronomic issues and avoid animals and buffers
- Idea was raised to use Buffalo creek as a demonstration sub-watershed to eliminate potential sources.
    - Soil test the entire watershed, right now only 10% of the watershed is testing soil in any given year and at best 20% test soil in any 5 year period.
    - Livestock population with P concentration vs. animal population

PERSONAL THOUGHTS

Mission: improve water quality
Vision: improve water quality through sediment and nutrient control
Objectives:

- Identify sources of WQ impairment (eliminate and research)
- Promote/introduce prudent practices
- Evaluate prudent practice
- Generate awareness of WQ problems and OCC efforts

Ideas:

1) Use Buffalo Creek to eliminate sources and promote/evaluate effective practices in the watershed
    a. Address P movement with soil erosion
    b. Prevent/reduce soil erosion
    c. Evaluate soil nutrient needs
    d. Evaluate ground water P
    e. Identify educational needs for the watershed
2) Design demonstration to include a combination of "small plots" and field scale plots. This will generate scientifically valid information as well as show farmers tangible results
3) Work with NRCS to get the buffers on line

00-06-29 Phone Call to COE (Shawneen)

- Shawneen has been working on a "Cimarron Basin Recon Study". Now they have to do something in the watershed
- We discussed the possibility of working together on a project on the Cimarron river. However, it was outside of our matching ability. We would need 75,000 to 150,000 cash to match.
- Changed objective to Turkey Creek.
    - There are two sources of funding1) GI (General Investigation) which requires an approval by congress each step of the way, but no upper limit on the funding; 2) continual___? Which the 206 falls under. Only a 35% match and all can be in-kind. Cannot match Feasibility Study with in kind--need to pay cash?
- They need to get something going in FY 2001 but could push it back
- She needs a letter by July 30, but would prefer it in the next few weeks

- I spoke to Scott about the idea and he seems interested. I'll draft a non-committal letter of intent to do work with them. They would like to meet in two weeks or so.

00-07-06 Phone Call to Dennis [redacted]

- Discussed the possibility of using ash in agricultural arena
- There is a problem with low pH in the area
- Tenet farming is very common; difficult to get them to spend the money to improve someone elses property
- Currently getting as from Deer Creek Water treatment plant. Wet sludge is shipped to Okarchie.
    - $8.50/ton
    - 90+% ECCE
    - $1.10/mile freight, but more like $8/ton actual cost
- Cost to the farmer with 90% ECCE lime
    - $8/ton freight
    - $9/ton product ($0.50 handling cost)
    - $5/ton application
    - **TOTAL = $22/ton**
- Estimated cost of ash 45% ECCE
    - $9.50 ton back haul rate
    - $0.50 handling; free ash
    - $5/ton application
    - **TOTAL= $15/ton, but you need 2 tons ($30/ton)**
- Economics are not looking good for this material.
- The only way we can get the economics down is by cutting transportation cost.
- If we look at rail lines then the cost of double handling become an issue. Johnston's is leery of stock piling the material also. They have been burned in the past.
- Need to check into rail prices, but there other problems that need to be address on the loading and receiving end.
- 153.1 mile from Chouteau to Enid ($336.82 per truck load or $13.47/ton of ash)
- $1450/train car from Chouteau to Enid on UP lines (estimate)

00-07-18 Conference Call with the COE

People: Shawneen O'Neil Sue Haslett (chief of planning)
Scott Stoodley **Canty**

Summary:

- Shawneen performed a recon study of the Cimarron river watershed. She was allowed $35,000 to 40,000 to evaluate previous data, site visits and other after the fact investigation. No new data was collected.
    - She has to document the results by July 30th.
- Scott talked about the large watershed projects that the OCC has going on. He said that the order of funding in the past has been
    - 1998 Eucha

  - 1999 Illinois
  - 2000 Wister
  - 2001 Turkey
- We tend to spend $1.2 million in an area
- Looking for a United effort

- Sue mentioned the COE has some money that may be appropriated by Oct 1 200 for Wister Lake ($500,000) this is a separate issue—need to get with them.
- The Turkey Crk project could be a GI or a 206 project. The General Investigation would require a 50:50 match on the Feasibility Study with 25% hard cash. Geoff asked if the 206 option would be possible. Sue stated that it could be. The project scope would determine which would be most suitable for this—depending on the cost.
- Letter of intent: Sue said she needs a letter of intent that states we want to work with the COE. No obligation.
- Feasibility studies are costly. Sue stated that this has cost from $500,000 to 1 million plus on other projects.

00-07-19 Call from John Hassell

- We discussed Turkey Creek and how we could coordinate Core4 in Oklahoma
- Debbie Car-not (sp?) in North Canadian CD purchased a no till drill
- Should contact Ed Frye to discuss a possible demonstration.
  - Need to talk to him about demos
  - Suggestions for getting the ball rolling
  - Ask what kind of support can we get from CORE4
- Need to call dale Hancock to start the ball rolling on Turkey Creek

00-07-19 Call to Roger Gribble

- Roger wants to "eliminate" potential sources of pollution
- He wants to look at P movement in soil. How much is really moving. How does that compare with organic mater that is left on the field. Perhaps look at no-till, conventional tillage
- Roger said next summer is the time to start
- He is going to put together a proposal and a budget
- I would like to use a large scale no-till operations with records to establish a demonstration farm.

00-07-19 Call To Dale Hancock- Conservancy District (?)

- We discussed Turkey Creek and what the OCC has in mind for the watershed
- I was trying to sell buffers, but he claims that is going to be a very tough sell.
- He is not against it, there are some practical issues that need to be addressed with regard to the NRCS programs.
- He said we can meet on Aug 7th between 2:00 and 3:00. He is going to mention it to his board.

- They have Conservancy District they are creating to build a flood control structure
- I said we might be able to augment the NRCS program with the implementation money from OCC. He has a sight near Lahoma a dairy that might be interested in some practices if the price is right (Mr. Brackage sp?)

00-07-27 Field Visit

People: Shawneen O'Neill Jim Randolph
Chris Hise Canty

Summary:

- Met Chris to look at the water sampling locations. We drove around the watershed to get a general picture of some specific sites. Went to Drummond flats, and north in the watershed
- Met Shawneen and Jim to show them the problem and started to discuss the situation from a general perspective. Jim talked about a project in Kansas were a watershed twice as big is under consideration for restoration.
- Drummond flats could be restored, up-land and riparian zone issues can be addressed.
- Also used the GPS to identify the litter-ash plots.
- Drove past the dairy near Lahoma. There was severe riparian zone erosion. There is a tributary that feeds into Turkey that the cattle have degraded.

Sites and photo GPS#

- Lower Turkey [redacted] Land Owner; Dover lagoon is just north east of the bank
  - Sandy soils
  - GPS 001: 1 Photo up stream
- Little turkey [redacted]. High NO3 and low P, maybe spring fed.
  - Water clear and riparian at bridge looks OK; obvious cattle access
  - GPS 002: 2 photos up and down stream
- Buffalo [redacted]? Leasor? Location on a WPA bridge,
  - steep grade change from creek to wheat filed above (hanging fence)
  - clay –shale soils
  - GPS 003: phots # 3 & 4
- Turky Middle old steel bridge, evidence of back erosion upstream
  - GPS 004
- [redacted] GPS 005
- Upper Turkey [redacted] to the west
  - Well house to NW was sampled
  - GPS 006
- Clear Creek GPS 007
- Dennis Craig GPS 008
- [redacted] GPS 009

00-09-27 Phone call to Carol Becker- USGS

- Spoke with Carol about her up coming monitoring effort. Her proposal has been cut in half—so she has heard, but no official noticed has been received. Groundwater portion is eliminated
- She can monitor 5 of the 6 sites Hise monitored
- I asked if have USGS grab samples for us, but we pay for them—no problem, no charge if we supply everything and do not require an additional time

00-10-09 Phone call to Steve Winters

Summary:

- Asked him if he would be interested in establishing a riparian demo in the watershed. He is very interested in the Little turkey watershed
- I said I want to coordinate with NRCS and their incentive programs. He said that NRCS is so rigid and inflexible that it would be a hard sell in the watershed—non-program. He was very disgusted.
- I said we could compliment the NRCS program, but design our own program. This would be used for a demo 2-3 year from now when we have the larger watershed project coming on.
- We meet on the 19th at 8:30- 9:00 for a tour.

00-10-19 Field Visit to Kingfisher County-- Steve Winters

Summary:

- Visited the Little turkey watershed to see if we can establish a demonstration project in the upper portion of the watershed.
- Steve has several interested landowners or landowners that have expressed interest in the past.
- It seems that we can get the upper 12-15 mi^2 of the watershed into conservation practices to address things such as nutrient, bacteria and sediment—grassed water ways and riparian buffers
- Steve developed an implementation plan for area and sketched what should be done on each property
- Needs
    - To establish a demo in Garfield and Alfalfa County
    - Need determine if Steve can write plans
    - Get a map of little turkey watershed –orthoquads
    - Find out about sampling money available

00-10-30 Phone call to Steve Winters

Summary:

- we need to change meeting date to November 14 at 8:30
    - visit to Garfield and Alfalfa to possible demos
- I suggested he contact Gary Schaeffer (NRCS) to invite him to the county and also the guy (Robert) from Alfalfa

- Steve has December 5th set up for a meeting with Lanny Miller (sp?) (NRCS); bring Scott with.
- Told Steve Shellie is developing a map for the area of interest.
- I told Steve to set-up a time to meet with Gary on the Nov. 14th.

00-10-30 Phone call to Dale Hancock

Summary:

- Told him about the COE meeting and mentioned how it will not be as straightforward be cause of matching money. May need to meet with an individual that can champion the process
- Also asked to get on the Conservancy district agenda—November 29th
- Told him about Steve's visit to Buffalo Creek and asked if he or Gary would like to attend. He said he would work out something.
    - He said they have a working relationship with Steve (no bad not necessarily good)
    - I said Steve would contact Gary

00-11-14 Phone call to Steve Winters

Summary:
There was some confusion on the say we were to meet to see Buffalo and Alfalfa sites. Steve had to cancel, but Lee Ann (District Secretary) tells me it was on his schedule. He is trying to reschedule a day to meet with Gary and Alfalfa county

00-11-20 Meeting with Steve Winters

- Meet Steve in Kingfisher Co. Drove to Alfalfa Co to meet with Robert Dotson
- Robert showed the wastewater treatment facility for the prison
- We located an approximate location for an upstream monitoring site on a friendly landowner
- Robert agreed with the limitations of NRCS programs and the ability to meet the needs of the producer.
- He sounds like he is interested in the general premise that Steve has presented
- He said there are a couple of producers that will be interested in the partial demonstration in the Turkey Creek watershed.

00-12-04 Meeting with Steve Winters

- OCC-WQ office
- Canty and Winters

Summary:

- We discussed the general plan of attack for the meeting with Lanny Miller
- Practices to include

  - Contour buffer planting grasses on backsize of terrace
  - Pasture and hay land plantings
  - Gully shaping
  - Critical area planting
    - Riparian
    - Salt area
  - Grassed water-ways
  - Filter strips
  - Range plantings adding desirable grasses to poor areas
- Gary Schaffer
  - Steve said he visited with Gary last week to discuss the various landowners in the watershed that may be interested in the small scale watershed
  - Possible producers
    - [redacted]
    - [redacted] major landowner in watershed; important producer, 1st cousin with [redacted]
    - [redacted] (Wheat Commission)
    - [redacted]-dairyman- farms 16,000 acres in the watershed major player that must be included
    - Steve stated there may be some bad blood between [redacted] and [redacted] with the NRCS over flood control structures in the watershed
- State Cost Share
  - Total of $14,400 per district
  - Jan 8th –12th open bidding time
  - There is a competitive process involved to avoid ear-marking funds
- Causes of water quality impairment
  - Sedimentation
  - Stream bank erosion
  - Nutrients
  - Bacteria

- Sources of problems
  - Riverlet and 1st order stream are plowed thru
  - "floodways" or what was the riparian zone of these 1st order stream are plowed thru
  - salt seepage areas
  - wet areas (difficult to plow)
  - poor management practices
- Issues to address before starting project
  - One sales person
    - Point of contact for the landowner
    - All issues are to be addressed by the salesperson
      - Signing the paperwork
      - Finances
      - Establishing the cost share
      - Developing the general plan

        - Tool box of options for the producer
            - NRCS plans
                - EQIP
                - CRP
            - State cost share
            - 319 project monies
    - Work with the other partners in the plan,
        - Not taking anyone's job from them, trying to help facilitate the entire process
        - Work to meet the farmer's needs and remove the limitations/restrictions associated with certain cost share programs
- Time Frame
    - State cost share is mid-January
    - Planting by Feb 1

00-12-04 Meeting with Phil

- OCC-WQ office
- Jeff & Phil

Summary

- Need to write a QAPP for the money before monitoring can begin
- Project number is FY 2000-900 (grant number and task number)
- Money available
    - $23,000 lab
    - $5,000 travel
    - $2,000 supplies
- Grant cost share
    - $20,000 from
        - QAPP review by district
        - Data review by district
        - Field collection
        - Landowner visits
        - District board meetings when discussed
    - Bill $15-20/hr rate

00-12-05 Field Vist to Little turkey Creek

- Steve Winters Jim Smith Lanney Miller
- Scott Stoodley Geoff Canty

Summary

- Visited the watershed with Lanney to see what is eligible for CRP and other NRCS programs. Lanney was extremely helpful in defining what can be applied for in NRCS CRP programs
- We discussed the what would be involved with the little Turkey watershed

  - NRCS wants full farm plans for each producer—no just small segments
  - Time restraints can be significant for this planting season. If we can work on one smaller segment of the watershed and expand over the next few years
  - Steve can do every aspect but sign the farm plan. He can compliment Jim Smith
- Lanney is just a technical person, he does not have any over sight on the DCs or the programs. If you wan them changed you will have to talk to people higher up
- Scott seemed to think there may be some issue with territory. Need to proceed carefully as not to offend or interject.

00-12-05 Phone Call to Shawnee

- Talked to hr about making Kingfisher the sponsor of the COE GI money.
- Talked about Steve Winter abilities and the benefits of having it situated in Kingfisher
- She seemed interested in the idea. She will get back to me.

00-12-18 Phone Call from Steve Winters

- Steve said Lanny Miller is going to train him as a plan writer for the farm plans—Jan 8 & 9th
- Coordinate Turkey with the COE GI funds. Steve's board is a go and they are in the process of writing a letter.
-

00-12-19 In house Meeting

- Kendra, Jim and Geoff

Summary

- Purpose was to bring Jim up to speed and to make sure I was fulfilling my project obligations
- Issue of importance identified
  - Look into the rosgen information to make sure it is complete and determine the utility
  - Establish eligible management practices
    - Need to set-up a cooperative agreement with the district for incentive rate
  - Outputs
    - Need up dated Workplan
    - Need to update the QAPP
    - Write a report on the Hise findings
    - Need to GIS map of the digitized watershed==calculate loadings
    - Need to form an advisory group

00-12-19 Phone Call Carol Becker

- Her work plan need revision—came back from EPA.
- Talk to her in Jan/Feb of 2001

01-01-03 Phone Call with Steve Winters

- He called to discuss his plans for the WAG
  - Board Members
    - One from each district (4 total)

        - [redacted] vet and [redacted] son-in-law
        - [redacted]—voag teacher & major landowner
        - [redacted]—major land owner
        - [redacted]—triangle COOP, Argonomist
        - [redacted] (sp) Federal Landbank private bank 10 counties around enid
        - [redacted]—School superintendent
    - We will create some type of mailing list and have informal meetings
    - I think we should invite all the DMs or DCs as well as OSU extension (Roger Gribble)
- We will meet in OKC on Jan 16th to discuss
    - Little turkey plan
    - Big turkey plan
    - 2001 monitoring program

01-01-11 Phone Call with Shawneen

- I told her I have not read the scope of project yet. I was meeting with Steve Winters on Tuesday and would discuss it with him in a little more detail
- For the GI all Feasibility Study money can be "in-kind" match
- She tells me all is well with the Kingfisher project
- I mentioned that Kingfisher County maybe overextending themselves with 2 massive projects. I have faith in Steve, but if Steve left the COE may have some problems finishing the project. I still want the project to go forward, but she should be aware of the situation.

01-01-17 Meeting @ OKC with Steve Winters

- We developed a plan for the Little turkey watershed
    - Split the upper LT into Two subprojects
        1. West LT (2001-2002)
        2. East LT (2001)
    - We are going focus immediately on East LT
        3. All ag land, no influence from urban area.
        4. Plan of attack
            - Farm Plans for priority areas
                - [redacted] sec 28
                - [redacted] NE 29; SW 29
                - [redacted] SE 29
                - [redacted] SW 32
                - Sec 33 (Steve to investigate what the high priority areas are)
            - Approval of landowners
            - Release of money
                - Estimating $10,000 (319)
                - $2000 was state cost share
                - Work with Jim to get Commissioners' approval
            - Develop sampling plan
                - Steve will find flow path in sec 31

- Jeff to talk with Dan about sampling locations
- Steve is going to investigate the 20, 29, & 31 on east to see if they should be included in East LT

- State Cost share
  - 2 land owners in LT were able to qualify ($2000 total)
  - Grass Planting was #1 priority
  - Maybe able to get some of the cost money later from others who have not qualifies
  - All money needs to be committed by July
- Farm Plans
  - Steve has been meeting with Lanney Miller (NRCS) and has been learning how to write farm plans—will be certified writer in the future
  - Steve wants to look at other things that are not necessarily in the scope of a typical FP
    - Septic systems
    - Oil field issues
    - County commissioner issues
    - Water wells
  - He has one just about finished on [redacted] property
  - We have prioritized the farm plans for East LT; plan on writing them for the entire upper LT watershed based on 1) Sediment, (2)Bacteria, and (3)Nutrients
  - Steve developed potential farm plans for the following landowners **(FEB 15th cost estimate and plans)**
    1. [redacted] (sec 28)
       a. BMPs
          i. Gully shaping,
          ii. pasture planting
          iii. Field prep
       b. Cost
          i. Total $2800
          ii. State $1000
          iii. 319 $1800
          iv. 25% cost share
    2. [redacted] (SW 29)
       a. [redacted] property
       b. BMPs
          i. Waterways
          ii. Grass plantings
          iii. Bar ditch repair (county commissioner)
    3. [redacted] (NW 32)
       a. BMPs
          i. He has already done some Jose Wheat grass planting; talked about moving his fence further west to reach terrace
    4. [redacted] (NE 32)
       a. Not much needed; some oil field problems (cicer milkvetch-grows on anything)
       b. Lower priority
    5. [redacted] (SE 32)

   a. BMPs
      i. Cross fencing
      ii. Water well ($2000) and tank
      iii. Rotational grazing
      iv. Plant legume
   b. Management practice to improve the resource; probably not a major contributor to WQ problem
   c. Lower priority
6. [redacted] (SW 32)
   a. No farm plan, but he has qualified for state cost share
   b. BMPs
      i. Grass planting
   c. Cost
      i. Total 3800
      ii. State 1000
      iii. 319 2800
7. [redacted] (NE & NW 29)
   a. BMP
      i. NW flood control structure needs some grass planting upstream
      ii. NE grassed waterway
8. [redacted] (SW 20)
   a. BMPs
      i. SESW 20 grassed waterway
      ii. NWSW 20 grass water way
9. Section 33
   a. Steve need to ground truth the area—too wet now
   b. Drain way were dug many years ago bring water from outside the watershed into LT
   c. Potential WRP project—Matt involved?
10. [redacted] (SW 10)
   a. BMP
      i. 10 ac of grass on corner of waterway
   b. Lower priority

- Advisory group
   a. Steve has 9 members that have agreed to serve

NAME	AFFILIATION	PHONE	
Matt Gard	Major County CD	[redacted]	
Jay Hague	Alfalfa Count CD		
Tim Taggart	Kingfisher Count CD		
Richard Wuerflein	Garfield County CD		
Jean Ann [redacted]	Hennessey landowner		MS Env Sci degree Duke?
Eric [redacted]	OK Wheatgrowers	[redacted]	Ex Director

	Assoc		
Roger [redacted]	Dumond vet/landowner	[redacted]	So-inlaw to Lew; COOP ties
Dennis [redacted]	Bank President	[redacted]	
Greg [redacted]	Drummond Public school Vo-Ag	[redacted]	Landowner in D-flats

- Steve's needs
    a. Shellie Rudd Arcview training
    b. GPS unit
- Next meeting
    a. Look at farm plans
    b. Determine water path ways
    c. 2000 monitoring project site identification
    d. Jan 26th Kingfisher (8:00-8:30)

01-01-31 Meeting with Steve Winters in Kingfisher

- We discussed the east side of the watershed. It seems that the watershed is actually further to the east. We will have to pick up a few other landowners.
- March 15 we are having a meeting of the advisory board
    - Steve drafted a letter—needs some work
    - Need to have everything in place (all farm plans) by 3/7
    - May need a meeting room and some food
    - Jeff to give a presentation on Turkey Creek and Little Turkey

01-02-01 Phone Call John Hassell

- John needs a champion in the watershed.—Steve Winters
- John is coming July with some Monsanto guy to and will stop by
- Maybe make it a National Project
- (I called Steve, he said his board is interested)

01-02-12 Drummond Flats Meeting

People

- Steve Winters Steve Tully (NRCS) Ken Williams (USFW)
- (Jontie Aldridge (USWF) Allen Stacy (ODWC) Matt Mercer
- Chris ? (NRCS) Chris Hise (TNC)

- Meeting was called originally to talk about Matt's grant, which did not materialize. So we talked about the other aspects in the watershed and what was going to occur
- It seems that one landowner purchased a piece of property for less than what NRCS is going to pay him in rental agreement—he making money. All the other landowners are looking to see what happens. 160 ac for $22,000-23,000. This seemed to be a hot topic
- There were two landowners with some interest in converting property to wetlands, but they do not have the interests because of the government requirements/restricts that are associated with the various programs.

- NRCS 75% cost share can be matched with 25% USFWS
- Playa lakes boundary has been extended which now includes the Drummond Flats area
- There has to be person to take charge in the watershed to develop a holistic plan and avoid the piecemeal approach. Matt should take this role. Then use the various incentive programs to fund the implementation.

01-02-27 Meeting (OACD)

- Meeting with several members of the watershed with representatives from all 4 counties and conservation districts
- Shawneen presented her PMP chapter 4 Scope of Study
- Steve told everyone there to have the boards look into it and make any changes
- Feasibility study
  - 50/50 cost share with 100% in kind service available
- Budget is yet to be drafted by COE
- COE would like to start by June 2001
- Major focus is Ecosystem Restoration not really flood or water quality

01-03-07 Meeting Steve Winters

- Met with Steve to discuss the status of the project
- All but three people in the Little Turkey East project have been contacted and have voice interested. Steve needs to meet with these others. Should be done before the March 15th
- Little turkey West should have everyone signed on by April 21st
- Tentative schedule to have Advisory Meeting on March 28th
- Need to have a meeting with Scott & Jim to finalize or OK the plans March 12th
- We start work on monitoring project in May
- We can look at the field runoff studies with the help of ARS in El Reno
- Need to develop a monitoring plan for the pre-implementation aspects now.

01-03-14 Meeting with Dan

- Talked to Dan about the monitoring in Little turkey
- He said you need to implement in 20% of the watershed before you see any improvement
- Need to flow weight data
- Recommends sampling for
  - NH_3, NO_3 but not (TKN or NO_2
  - OP & TP
  - SO_4 Cl
  - Bacteria –
    - Fecal
    - E Coli
    - Enterococcus
  - TSS and SS

- He recommended sampling at base flow but most improvement will be seen during the high flow events. Depth integrated bomb or perhaps on grab in the thalwag
- Best to grab the sample at the peak of the hydrograph.
- He liked the idea of isolating the eastern little turkey from the west and also suggested nesting a site within the western little turkey watershed.

01-03-16 Meeting with Scott & Jim

Steve Geoff Jim & Scott

Turkey Creek Watershed
Demonstration Project

MEETING AGENDA
March 16, 2001

Review and Overview of Work to Date
- East & West Little Turkey discussion by geoff
- Landowner participation discussion by steve
- General strategy geoff discussed our general plan of attack

Technical Aspects
- Farm plans (whole vs farmers needs)
- Technical specifications Scott wants use to follow proper specs to prevent any discrepancies or inquiry
  - Equip List
  - State Cost Share need to develop a document of accepted practices and present them to the district boards for approval and setting of rates and caps
- Dates and timing of implementation BMPs need to visit with otis and joe
- Alternative mixes—CW Johnston's may be a conflict of interest, cannot promote no advertisement

Advisory Group
- Role
- Members need a person from the city (NODA?)
- Meeting date
- Future Scott thought it was ok to have this board step into the big turkey role later on

Scott views:
1. advisory does not make final decision
2. WAG chairperson is critical
3. need support of WAG to make project fly

Time Table

Education April/may
Technical stuff April/May
Sign-up June/July
Party fall 2001
Review Success fall 2002

FY 2002 Implementation Project

Grant probably submitted in 2002
Possible approved in march –may 2002
Money by fall 2002(?)

01-03-28 Phone call to Larry Tripp (NODA)

- Invited Larry to participate on our advisory board. We need city representation on the group.
- He said he was interested
- We can use their meeting/conference room in Enid as well (20 people)
- Larry has 80 acres on Turkey; seems to have knowledge about all of the area.
-

01-03-28 Phone call to Steve Winters

- Talk to Steve about getting these Farm plans written.
- I called Otis and told Tommy to schedule the week of the 16-19th for Otis and Mike to come out and help with plans.

01-04-19 Phone call to Steve Winters

- Talked to Steve about the Otis visit
  - Went well
  - Otis likes the WAG board
  - Otis is going to develop a list of BMP
    - Kingfisher board needs to approve list (may 9th)
  - Once BMPS are approved then we need farm plans
    - Scott approval
    - ½ day Joe will help
  - Grass planting are acceptable for most of it
  - Need to visit with Otis

01-04-20 Phone call to Otis

- Talked to Otis about the Turkey Creek visit
  - Agrees with Steve's general plan
  - Call it buffer or critical area
  - He is developing a list of BMPs (Otis and Joe)
  - Otis suggests taking it to the WAG then district and then the commissions
  - State cost share rates are 50%
  - Develop a ranking system,
  - Otis thinks this is an ideal situation

- o

01-04-24 Meeting with DEQ about TMDL for Turkey Creek

- Several people present from DEQ meeting to develop a strategy for their TMDL plans. One issue was a TMDL for Turkey Creek
- Need a WRAS for turkey
- DEQ is planning on a TMDL in 2003
- $30,000 in the FY 2000 grant is for WRAS and TMDL support
- Turkey is listed for sediment, nutrients and pesticides on one segment
- Bob Bender needs a data summary of everything we have
- Questions:
  - Who will write the QAPP
  - What kind of TMDL—modeling or monitoring + modeling
  - Can I use any of the money for my monitoring
  - Bacteria is not on the TMDL list but is should be.
  - Can I use the additional Task 86 money for monitoring in the watershed?

01-04-24 Post Meeting with DEQ about TMDL for Turkey Creek

- Meeting with Phil and Kendra
- Process seems out of order to me
  - WRAS-outlines action needed
  - 303d listed means there is a problem and we can identify ways of addressing the problem
- Ideal process:
  - Monitoring
  - 303d listing (based on monitoring)
  - Diagnostic monitoring (?)
  - TMDL
  - Diagnostic monitoring (?)
  - WRAS
  - 319 implementation
  - Follow-up monitoring
- Ideal turkey Creek Process
  - 2001-2002 diagnostic monitoring
  - 2002-2003 TMDL
  - 2003 diagnostic monitoring & WRAS
  - 2003-2008 implementation and monitoring
- Kendra said:
  - 1999 grant DEQ Ft Cobb (2002) money is open. OCC is to support TMDL development. OCC money has to be spent in 2001 and will expire in 2003
  - 2000 grant was for support of Turkey Creek TMDL & WRAS.
  - May be able to use 99 and 00 money for turkey because Ft Cobb is in good shape
  - End of May there will be a meeting to go over the specific & data: no QAPP until after that meeting.

01-09-19 Meeting with USGS

- PEOPLE:

Carol, Mike Houts, Steve Winters, Canty

- Discuss USGS/DEQ project
-

01-10-08 Meeting with Steve (Kingfisher)

- went through location site for $30,000 project

01-10-10 Phone call from Carol (USGS)

- Canceled the meeting with Houts and USGS
- DEQ is interested in doing groundwater portion
- I tried to persuade Carol looking at phosphorous
    - She is interested, but will ask one of their geochemist to learn about OP movement
- About $50,000 for ribo-typing
    - $24,000 for 400 isolets (unknown) and $6,000 for known isolets
    - lab work would run $11,000 (isolation)
    - no sampling time
    - Equipment $4,500
- STAR grant application help out in monitoring program
- Nitrogen isotopes $65/anaysis (Boston University-Bob Mitchner) $135 USGS

02-01-28 Meeting with Project Advisors

- Jim Dan Kendra Shanon
- See notes in journal for more detail
- Jeff needs to come up with a total cost needed for Upper east Little Turkey

02-02-04 Field Visit

- Carr, Woodfin, Mercer
- Visited site to show them the situation
- Sampled all three sites
    - Severe ice damage

02-02-18 Meeting with Project Advisors

- Jim Dan Kendra Shanon
- See notes in journal for more detail

- Highlights
  - Dan will check on Bermuda cost share increase
  - Need to get a copy of the agreement
    - Could last 3-5 years
    - May have to fence out jose for life of demo
    - Tech writer will address Output X003 (Big Turkey WQ) & X004 (GIS)
    - Sign up as much of western turkey as you can with money you have available—focus on Ag issues
    - I still have 36,000