

**MARK CREEK  
DEMONSTRATION PROJECT**

**OCC Tasks 20 and 21  
FY 1990 319(h) Task 210  
EPA Grant # C9-006704-90-0**

Submitted by:

Oklahoma Conservation Commission  
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FINAL REPORT  
September 1997

## **Acknowledgements**

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The efforts of the Deer Creek Conservation District and Weatherford Field Office are also greatly appreciated.

Funding for this project was provided by the U.S. Environmental Protection Agency – Region VI Nonpoint Source Program (Section 319(h) of the Clean Water Act) and the State of Oklahoma.

## Table of Contents

Title	1
Acknowledgements	2
Table of Contents	3
Background	4
Mark Creek Pre-Implementation Monitoring Results	6
Base Flow Monitoring Results	6
High Flow Monitoring Results	10
Conclusions from Pre-Implementation Monitoring	10
Implementation Activities	12
Mark Creek Post-Implementation Monitoring	13
Conclusions	13
Literature Cited	14
Appendix A – Water Quality Data: Mark Creek Project	15
Appendix B – Bacteriological Data: Mark Creek Project	21

## **Background**

The primary objective of this project (FY 1990 §319(h) Task 210) was to carry out a demonstration project to control agricultural NPS pollution in the small Mark Creek watershed near Thomas, Oklahoma within the Canadian River basin.

The Canadian River watershed between Canyon View Creek near Bridgeport to Rough Creek near Thomas is located in parts of Custer and Blaine Counties within Oklahoma Water Quality Management Plan Segment 520620-01. Mark Creek, which is a small tributary to the Canadian River located near the town of Thomas in Custer County, has a drainage area of about 3,400 acres (Figure 1). In the Section 319 NPS Assessment Report (OCC 1988), agriculturally related concerns were documented in the Canadian River around Bridgeport related to elevated levels of fecal coliform bacteria likely associated with animal wastes. Within the Mark Creek watershed area, probable sources include animal wastes from cattle in pastureland along the Canadian River floodplain and terraces, wastes from cattle grazing seasonally on cropland (mainly winter wheat), and from dairy operations. Animal wastes could enter the Canadian River where cattle congregate close to watercourses, from animal wastes around dairy operations, and in sediment washed in from erosion sites on pasture or cropland where cattle are grazed.

The major project activities included:

- 1) determining the BMP needs of landowners in Mark Creek watershed,
- 2) submitting a Quality Assurance Project Plan (QAPP) and monitoring plan to EPA,
- 3) soliciting landowner sign-up (target of 70% participation),
- 4) conducting water quality monitoring, and
- 5) implementing BMPs.

Agencies involved include the Oklahoma Conservation Commission, the Deer Creek Conservation District, and the Natural Resources Conservation Service.

The Oklahoma Conservation Commission coordinated with the district to administer the distribution of project funds to landowners participating in the demonstration project and carried out water quality monitoring.

# Mark Creek Demonstration Project Sampling Sites

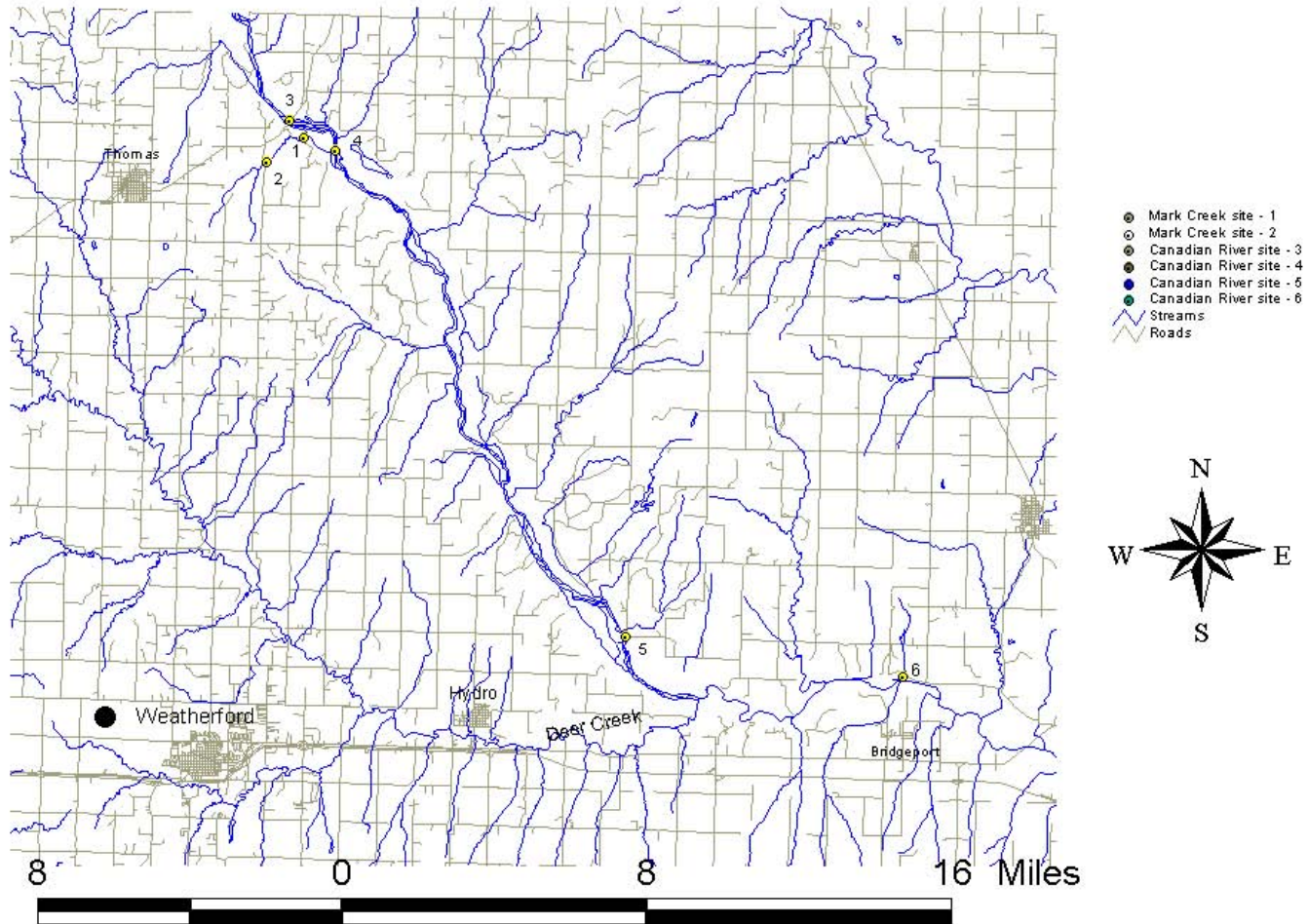


Figure 1. Location of Mark Creek Project and sampling sites.

## Mark Creek Pre-Implementation Monitoring Results

Prior to implementation (September, 1990 to December, 1992), two sites on Mark Creek and four sites along the Canadian River (Table 1) were monitored to determine water quality. Pre-implementation water quality data is included in Appendix A. Mark Creek's beneficial uses are *Agriculture, Industrial and Municipal Process and Cooling Water, Aesthetics, Warm Water Aquatic Community, and Primary Body Contact Recreation*. The beneficial uses of the Canadian River are *Emergency Water Supply, Warm Water Aquatic Community, Agriculture (Class 2), Municipal and Industrial Process and Cooling Water, Primary Body Contact Recreation, and Aesthetics* (OWRB 1995).

Table 1. Site numbers, names, and waterbody I.D. numbers for Mark Creek Project.

Site #	Site Name	WBID#
1	Mark Creek Site 1 (lower)	OK520620010137G
2	Mark Creek Site 2 (upper)	OK520620010137V
3	Canadian River near Thomas	OK520620010010S
4	Canadian River East of Thomas	OK520620010010P
5	Canadian River near Hydro	OK520620010010K
6	Canadian River near Bridgeport	OK520620010010G

An ISCO automatic sampler was located at the lower Mark Creek site (Site 1) to collect high flow samples. The upper Mark Creek site (Site 2) was located approximately one mile upstream from Site 1. Site 3 (Canadian River near Thomas) was located approximately one-half mile upstream of the Mark Creek confluence near the Highway 33 bridge. Site 4 (Canadian River East of Thomas) was located roughly two miles downstream of the Mark Creek confluence. Site 5 (Canadian River near Hydro) was located about seventeen miles downstream of the Mark Creek confluence on the Groendyke Ranch. Site 6 (Canadian River near Bridgeport) was located an estimated twenty-eight miles downstream of the Mark Creek confluence near a USGS gauging station. Figure 1 shows the locations of all sites monitored during the Mark Creek project.

### Base Flow Monitoring Results

Excluding the dissolved oxygen (D.O.) level on August 19, 1991 in the Canadian River near Thomas (Site 3), D.O. levels were compliant with the OWQS (5 mg/L from June 16 – March 31 and 6 mg/L from April 1 – June 15). This low D.O. level (3.5 mg/L) threatens the *Warm Water Aquatic Community* in the Canadian River near Thomas. Mean D.O. concentrations (Table 2) in the Canadian River tended to increase as the water flowed downstream.

The pH in Mark Creek complied with the OWQS criteria (6.5-9.0) throughout the project; however, exceedances of the OWQS pH criteria (OWRB 1995) were observed at two Canadian River sites (Sites 3 and 6) on January 16, 1992 (9.2 and 9.3 respectively). This may indicate that the *Warm Water Aquatic Community* in the Canadian River is threatened. No pH trends were observed.

Table 2. Mean concentrations during the Mark Creek pre-implementation monitoring.

	D.O.	pH	Cond.	Temp .	Turb.	Alk	Cl	SO4	Hard.	TDS	TSS	TP	PO4	NO2	NO2/NO3	TKN	TN	NH3-N
Site	mg/L	S.U .	uS/cm	*C	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Mark Creek - Site 2	9.9	8.5	521	14.3	14.2	226	43	47	233	344	26.3	0.169	0.164	0.03	0.76	1.18	1.94	0.21
Mark Creek - Site 1	10.0	8.4	642	14.1	12.8	230	27	93	269	424	18.8	0.130	0.087	0.02	0.80	0.54	1.34	0.12
<b>Mark Cr Site 1-Hi Flow</b>			<b>301</b>		<b>1127.0</b>	<b>144</b>	<b>21</b>	<b>61</b>	<b>171</b>	<b>199</b>	<b>1535.5</b>	<b>0.579</b>	<b>0.237</b>	<b>0.08</b>	<b>0.48</b>	<b>2.75</b>	<b>3.23</b>	<b>0.25</b>
Mark Creek - Site 3	9.6	8.4	2285	14.7	21.9	172	265	623	752	1508	28.1	0.049	0.014	0.01	0.33	0.60	0.92	0.05
Mark Creek - Site 4	9.7	8.3	2087	15.1	22.9	178	252	537	691	1378	29.1	0.053	0.016	0.01	0.38	0.59	0.97	0.04
Mark Creek - Site 5	10.1	8.4	1953	16.4	23.3	181	241	479	638	1289	32.0	0.053	0.021	0.01	0.31	0.63	0.94	0.05
Mark Creek - Site 6	10.9	8.5	1687	17.0	31.8	181	170	479	676	1113	52.9	0.102	0.073	0.03	0.50	0.66	1.16	0.06

The OWQS turbidity criterion (50 NTU) was not exceeded in the Mark Creek base flow samples; however, on June 11, 1991, the turbidity criterion was exceeded at all Canadian River sites. The turbidity criterion was also exceeded at several Canadian River sites on January 16, 1992 and September 5, 1991. This indicated the *Warm Water Aquatic Community* and *Aesthetic* value of the Canadian River was threatened by turbidity. Mean turbidity varied little between the two Mark Creek sites. Mean turbidities also varied little between Canadian River Sites 3, 4, and 5. However, a marked increase in mean turbidity between Sites 5 and 6 was apparent. Between Sites 5 and 6, a large tributary, Deer Creek, enters the Canadian River and likely caused the increased turbidity.

Similarly, mean total suspended solids levels varied little between the upper and lower Mark Creek sites. Mean TSS levels in the Canadian River decreased slightly between Sites 3, 4, and 5. However, a marked increase in TSS between Sites 5 and 6 was observed. This was also attributed to the inflow from Deer Creek.

Alkalinity varied little from site to site in both Mark Creek and the Canadian River. Alkalinity levels at all sites indicated the water had a substantial buffering capacity (alkalinity > 100 mg/L). The water was very hard at all sites (hardness > 180 mg/L). Average hardness generally increased in Mark Creek as the water flowed downstream, while it decreased as the water moved downstream in the Canadian River from Site 3-5. However, a slight increase between Sites 5 and 6 was observed which was likely due to the inflow of Deer Creek between the two sites.

Sulfate and chloride levels in Mark Creek complied with the OWQS yearly mean standards (310 mg/L Cl and 557 mg/L SO<sub>4</sub>) and sample standards (456 mg/L Cl and 695 mg/L SO<sub>4</sub>). However, on two occasions (May 7, 1991 and July 3, 1991) chloride levels an order of magnitude higher than usual were observed. On these two days only, the Safe Drinking Water Act (SDWA) Secondary Maximum Contaminant Level (MCL) for chloride (250 mg/L) was exceeded in Mark Creek. It was suspected that oil field activities in the watershed resulted in these elevated levels. The mean chloride level decreased between the upstream and downstream sites, while the mean sulfate level increased.

Excluding the mean sulfate level in the Canadian River near Thomas (Site 3), mean chloride and sulfate levels complied with the OWQS yearly mean standards. In contrast, the OWQS sample standards for both sulfate and chloride were exceeded at all Canadian River sites except for Site 4 (Canadian River East of Thomas) where the observed chloride levels were compliant with the OWQS chloride sample standard. The mean chloride levels decreased slightly between Canadian River Sites 3, 4, and 5; and decreased substantially between Sites 5 and 6. Mean sulfate levels also tended to decrease in a downstream manner in the Canadian River. Most of the observed sulfate and chloride levels in the Canadian River exceeded the SDWA Secondary Maximum Contaminant Levels (250 mg/L SO<sub>4</sub> and 250 mg/L Cl). In addition, the levels of sulfate in the Canadian River were present at levels that cause taste problems in the water (SO<sub>4</sub> > 300 mg/L). The levels of sulfate and chloride in the reach of the Canadian River studied generally make it unacceptable for use as a public water supply.

Conductivity was used to estimate TDS levels as follows: TDS (mg/L) = Conductivity (uS/cm) x 0.66. Based on this, the TDS levels in Mark Creek were compliant with the OWQS yearly mean



standard (1463 mg/L) and sample standard (1841 mg/L). None of the TDS levels in Mark Creek exceeded the SDWA Secondary MCL. In addition, the TDS indicated the water was suitable for *Class I Agricultural Irrigation* (TDS < 700 mg/L) and for watering all species of livestock (TDS < 1000 mg/L). Mean TDS concentrations increased between the upstream and downstream Mark Creek sites.

Conductivity in the Canadian River indicated the water was somewhat brackish (TDS > 1000 mg/L). Over 90% of the samples contained TDS levels exceeding the SDWA Secondary MCL (500 mg/L) indicating it did not provide an acceptable source of drinking water. The TDS levels also indicated the water was suitable for only *Class II Agricultural Irrigation* (TDS = 700-2,100 mg/L) and was satisfactory for watering most classes of livestock (except poultry); however, it may cause mild, temporary diarrhea. Mean TDS levels decreased in downstream order. Because of this, the two furthest downstream sites (5 and 6) were compliant with both the OWQS TDS yearly mean standard and sample standard, while site 4 exceeded the sample standard and site 3 exceeded both the yearly mean standard and sample standard.

Both nitrogen and phosphorous concentrations decreased between the upper and lower Mark Creek sites. However, the nutrient concentrations at both sites were significant. Fifty percent of the total phosphorous levels at the upper Mark Creek site and 43% of the levels at the lower Mark Creek site were greater than 0.10 mg/L. EPA (1986) suggests that phosphorous levels in streams not exceed 0.10 mg/L. The reduced nutrient levels at the lower site likely resulted from dilution due to runoff from the primarily rough terrain rangeland in the lower end of the watershed. The upper end of the watershed is more gently sloping and contains more land in agricultural production and dairies. This indicated that implementation activities should focus on the upper end of the watershed.

Nitrogen and phosphorous concentrations changed little between Sites 3, 4, and 5 along the Canadian River. However, nutrient concentrations increased considerably between Sites 5 and 6 on the Canadian River. This again indicated the inflow from Deer Creek impacted the Canadian River. Future projects should address the problems in Deer Creek.

Ammonia nitrogen in the upper Mark Creek site (2) on March 26, 1992 exceeded the chronic criteria listed in the EPA *Gold Book* for the observed temperature and pH (0.39 mg/L). The ammonia nitrogen level at the lower Mark Creek site (1) on December 10, 1991 also exceeded the *Gold Book* chronic criteria (0.13 mg/L). These levels threatened the *Warm Water Aquatic Community* in Mark Creek. Ammonia levels in the Canadian River were compliant with the water quality standards.

Fecal coliform bacteria levels (Appendix B) were also monitored in base flow samples, because several dairy operations in the watershed were suspected of being significant sources of bacteria and nutrients.

Fecal coliform bacteria numbers decreased substantially between the upper and lower Mark Creek sites (2 and 1, respectively). However, fecal coliform bacteria levels were extremely high at both sites which indicated they did not support their *Primary Body Contact Recreation (PBCR)* beneficial use. In the Canadian River, a substantial increase in fecal coliform bacteria was observed between Sites 3 and 4 due most likely to the Mark Creek inflow. Above the Mark Creek confluence, the Canadian River (Site 3) support status of the *PBCR* use was “fully supporting but threatened”, while Site 4 below the Mark Creek confluence was only “partially supporting” the *PBCR* use. From Canadian River Sites 4 through 6, the fecal coliform bacteria levels exhibited a downward trend. However, the support status at these sites (4, 5, and 6) was only “partially supporting” the *PBCR* use.

#### High Flow Monitoring Results

High flow water quality was monitored at Site 1 only. Due to insufficient data, comparisons of high flow and base flow D.O., pH, and temperature levels could not be made. High flow conductivity, chloride, sulfate, hardness, and TDS levels were substantially lower than base flow levels. High flow TDS, alkalinity, chloride, sulfate, hardness, and conductivity levels were 53%, 38%, 22%, 34%, 36%, and 53% lower, respectively. These measurements provided a good indication of the dilution from rainfall, which typically contains low levels of dissolved substances.

Conversely, high flow TSS and turbidity levels were over 8000% higher than base flow levels which indicated sediment loading from nonpoint sources was significant. High flow total phosphorous and phosphate levels were also substantially higher than base flow levels (346% and 173%, respectively) which indicated that their runoff from nonpoint sources was also considerable. The mean concentrations of all forms of nitrogen, except nitrate, were also substantially higher in high flow samples than in base flow samples, which resulted in an increased high flow total nitrogen concentration. This provided further indication of the impact of nutrient loading on Mark Creek from nonpoint sources.

#### Conclusions From Pre-Implementation Monitoring

Pre-implementation monitoring indicated Mark Creek was suitable for use as *Class I Agricultural Irrigation* and watering all classes of livestock. However, its *Aesthetic* value was threatened by nutrients, while its *Warm Water Aquatic Community* was threatened by ammonia and nutrient enrichment. Mark Creek did not support its *Primary Body Contact Recreation* use due to high levels of fecal coliform bacteria. High flow monitoring of Mark Creek indicated nutrient and sediment loading impacted Mark Creek. Sources of nutrients included free range cattle, dairy operations, and crop land. Sources of sediment included animal holding areas, cropland, and gullies and headcuts in pastureland. The primary source of the fecal coliform bacteria was the dairy operations. Additionally, oil field activities likely resulted in several noticeable peak chloride concentrations in Mark Creek. Implementation efforts should work to address these concerns.

Pre-implementation monitoring indicated the Canadian River was only suitable for *Class II Agricultural Irrigation*. The water was satisfactory for watering most livestock (excluding poultry), but it may cause mild, temporary cases of diarrhea. The Canadian River is classified as an *Emergency Water Supply*. No standards are listed in the OWQS for this designation. However, the sulfate, chloride, and total dissolved solids levels at all Canadian River sites, which generally exceeded their corresponding SDWA Secondary Maximum Contaminant Levels, indicated it was not suitable for use as a water supply.

At Canadian River Site 3 above the Mark Creek confluence, the *Warm Water Aquatic Community* use was fully supporting but threatened by depleted dissolved oxygen and elevated pH. Additionally, the *Primary Body Contact Recreation* use at this site was fully supporting but threatened by fecal coliform bacteria.

At Canadian River Site 4 below the Mark Creek confluence, the *Warm Water Aquatic Community* and *Aesthetics* uses were fully supporting but threatened by turbidity. However, Site 4 was found to be only partially supporting its *Primary Body Contact Recreation* use due to elevated fecal coliform bacteria levels. Because the fecal coliform levels at this site were elevated when compared to Site 3, it appears that the Mark Creek inflow impacted the Canadian River.

The *Warm Water Aquatic Community* and *Aesthetic* beneficial uses at Site 5 on the Canadian River were also found to be fully supporting but threatened by elevated levels of turbidity. Site 5 was also found to be only partially supporting its *Primary Body Contact Recreation* use due to elevated fecal coliform bacteria levels. It was not known if the fecal coliform bacteria at this site originated from Mark Creek or from other sources.

The *Warm Water Aquatic Community* beneficial use at Site 6 on the Canadian River was fully supporting but threatened by elevated pH, turbidity, and nutrient levels. The *Aesthetic* value of the Canadian River was also fully supporting but threatened by elevated turbidities and nutrients. As with Canadian River sites 4 and 5, Site 6 was only partially supporting its *Primary Body Contact Recreation* use due to elevated fecal coliform bacteria levels.

Turbidity, total suspended solids, and nutrient levels increased considerably between Sites 5 and 6. Because Deer Creek, a large tributary of the Canadian River, enters between the two sites, it was assumed that the increase in these concentrations results from its inflow. Future implementation projects should address these pollutants in the Deer Creek watershed.

**Implementation Activities**

The Mark Creek demonstration project promoted the installation of water quality oriented BMPs designed to eliminate the introduction of pollutants associated with animal wastes and erosion to watercourses. This project promoted the water quality oriented BMPs listed below and contained in the agricultural component of Oklahoma's EPA approved Section 319 NPS Management Plan.

<u>BMP Description</u>	<u>BMP # from 319 Management Plan</u>
Filter Strips	8
Confined Animal Facility Runoff Management System	16
Diversions	16
Livestock Exclusion	18
Grade Stabilization Structures	19
Grassed Waterways	20
Stream Bank Protection	21
Critical Area Erosion Control	22
	27

The funds budgeted for this project were as follows:

BMP Implementation	\$134,000
Education/Technical Assistance/Technical Transfer	\$ 39,805
Monitoring	\$ 48,597
Administration	<u>\$ 7,467</u>
Total Funds for Project	\$229,869

Of the budgeted funds, the federal share was \$137,921 and the non-federal share was \$91,948.

Implementation began in the fall of 1993. The following BMPs (Table 3) were implemented.

Table 3. BMPs implemented in Mark Creek watershed.

<b>Best Management Practice</b>	<b># of Jobs</b>	<b>Area</b>
Permanent Vegetative Cover Establishment	5	44.5 acres
Agricultural Waste Control Facilities (Lagoon)	2	N/A
Grassed Waterways	1	0.5 acres
Diversions	3	4.9 acres
Permanent Vegetative Cover on Critical Areas	7	7.7 acres
Grade Stabilization Structure	10	N/A
Special Projects (Roofing)	1	35,964 ft <sup>2</sup>
Reduction of Agricultural Pollutants (Lagoon)	1	N/A
Pastureland & Hayland Management	1	49.5 acres
Conservation Cropping Sequence	6	855.3 acres
Nutrient Management	5	637.2 acres
Proper Grazing Use	5	1482.1 acres

## **Mark Creek Post-Implementation Monitoring**

Post-implementation monitoring is scheduled to begin in September 1997 to document improvements in water quality associated with reductions in the levels of bacteria, sediment, and nutrients. Funding for post-implementation monitoring will be provided from other sources. An addendum to this report will be sent to EPA upon completion of the post-implementation monitoring. The addendum report will compare the pre- and post-implementation monitoring results and determine the success of the project.

## **Conclusions**

As the pre-implementation monitoring showed, there was a definite need for BMP implementation in the Mark Creek watershed. Success cannot be determined at this time. But recent qualitative observations of Mark Creek and its watershed indicate that vast improvements have been made.

## Literature Cited

EPA (U.S. Environmental Protection Agency). 1986. Quality Criteria for Water 1986. EPA Publication 440/5-86-001. Washington, DC.

OCC (Oklahoma Conservation Commission). 1988. Oklahoma's Nonpoint Source Pollution Assessment Report. OCC – Water Quality Division, Oklahoma City, OK.

OWRB (Oklahoma Water Resources Board). 1995. Oklahoma's Water Quality Standards 1995. Oklahoma Administrative Code 785:45. Oklahoma City, OK.

APPENDIX A

WATER QUALITY DATA:  
MARK CREEK PROJECT

		D.O.	pH	Cond.	Temp.	Turb.	Alk	Cl	SO4	Hard.	TDS	TSS	TP	PO4	NO2	NO2/NO3	TKN	TN	NH3-N
Site	Date	mg/L	S.U.	uS/cm	*C	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Mark Creek - Site 6	10/02/90						162	21	247	885		22	0.099			0.80	0.25	1.05	
Mark Creek - Site 6	10/16/90	9.7	8.4	1201	18.0	4	166	22	435	599	793	14	0.073			0.90	0.15	1.05	
Mark Creek - Site 6	11/07/90		8.3	1572	6.8	32	203	24	536	841	1038	76	0.417			0.70	0.74	1.44	
Mark Creek - Site 6	11/20/90	13.2	8.7	1529	16.4	14	177	93	550	780	1009	21	0.073			<b>0.05</b>	0.29	0.34	
Mark Creek - Site 6	12/04/90	14.2	8.3	1660	7.0	8	197	118	442	717	1096	29	0.160			1.10	0.55	1.65	
Mark Creek - Site 6	01/03/91	12.5	7.6	1722	0.0	7	263	86	466	899	1137	21	<b>0.003</b>			0.60	0.45	1.05	
Mark Creek - Site 6	02/05/91	10.3	8.5	2070	12.4	37	202	259	395	752	1366	70	0.005			0.60	1.01	1.61	
Mark Creek - Site 6	03/05/91	10.8	8.5	1986	18.4	23	177	222	259	646	1311	64	0.054			0.20	1.28	1.48	
Mark Creek - Site 6	04/02/91	10.1	8.6	2040	17.1	24	170	236	749	687	1346	47	0.039			0.20	1.46	1.66	
Mark Creek - Site 6	05/07/91	9.7	8.8	2080	18.9	35	170	489	371	762	1373	55	<b>0.003</b>			0.20	0.69	0.89	
Mark Creek - Site 6	06/11/91	8.4	8.6	2030	28.2	77	210	312	498	552	1340	134	<b>0.003</b>			<b>0.05</b>	0.59	0.64	
Mark Creek - Site 6	07/03/91	7.8	8.2	1527	23.4	42	135	222	893	443	1008	2	<b>0.003</b>			<b>0.05</b>	0.93	0.98	
Mark Creek - Site 6	07/18/91	9.9	8.5	947	30.5	21	54	40	393	392	625	13	0.066			0.20	1.18	1.38	
Mark Creek - Site 6	08/19/91	15.4	8.5	854	29.5	9	126	17	318	394	564	7	0.044			0.10	0.57	0.67	
Mark Creek - Site 6	09/05/91	7.5	8.3	1053	27.5	103	112	105	628	575	695	276	0.300	0.050	0.03	0.60	0.70	1.30	0.03
Mark Creek - Site 6	10/03/91	11.6	8.6	1182	23.4	11	208	53	195	476	780	1	0.140	0.070	0.02	0.34	0.60	0.94	0.02
Mark Creek - Site 6	11/05/91			1350		23	198	124	665	978	891	18	0.170	0.130	0.01	1.40	0.70	2.10	0.19
Mark Creek - Site 6	12/10/91	12.4	8.8	2230	9.6	31	210				1472	56	0.070	0.070	0.03	0.68	0.30	0.98	0.03
Mark Creek - Site 6	01/16/92	13.0	9.3	1880	0.4	76	252	150	472	630	1241	88	0.160	0.080	0.03	0.68	0.60	1.28	0.08
Mark Creek - Site 6	02/13/92			2630		32	219	353	475	710	1736	53	0.130	0.070	0.04	0.53	0.40	0.93	0.04
Mark Creek - Site 6	03/26/92	9.0	8.7	2190	19.2	28	189	445	593	810	1445	44	0.140	0.040	0.02	0.45	0.50	0.95	0.01
	Min.	7.5	7.6	854	0.0	4	54	17	195	392	564	1	0.003	0.040	0.01	0.05	0.15	0.34	0.01
	Max.	15.4	9.3	2630	30.5	103	263	489	893	978	1736	276	0.417	0.130	0.04	1.40	1.46	2.10	0.19
	Mean	10.9	8.5	1687	17.0	32	181	170	479	676	1113	53	0.102	0.073	0.03	0.50	0.66	1.16	0.06
	Median	10.3	8.5	1691	18.2	26	189	121	469	699	1116	44	0.073	0.070	0.03	0.53	0.60	1.05	0.03
Mark Creek - Site 5	10/02/90						122	42	245	562		8	0.007			1.30	0.19	1.49	
Mark Creek - Site 5	10/16/90	10.4	8.1	1105	19.3	3	135	35	334	480	729	10	<b>0.003</b>			<b>0.25</b>	0.11	0.36	
Mark Creek - Site 5	11/07/90		8.4	1660	4.0	12	195	54	555	820	1096	25	0.420			<b>0.25</b>	1.47	1.72	
Mark Creek - Site 5	11/20/90	9.8	8.5	1866	16.2		159	181	615	895	1232	18	0.013			<b>0.05</b>	0.24	0.29	
Mark Creek - Site 5	12/04/90	14.2	8.3	2000	5.0	11	202	215	513	752	1320	27	0.044			0.50	0.59	1.09	
Mark Creek - Site 5	01/03/91	13.0	7.4	2020	0.0	5	263	149	515	915	1333	20	<b>0.003</b>			0.60	0.45	1.05	
Mark Creek - Site 5	02/05/91	10.8	8.6	2310	11.7	31	204	341	377	698	1525	66	0.011			0.30	0.90	1.20	
Mark Creek - Site 5	03/05/91	10.4	8.5	2290	17.4	15	185	305	262	648	1511	39	0.022			<b>0.05</b>	1.04	1.09	



Mark Creek - Site 5	04/02/91	9.8	8.6	2410	16.8	19	158	351	720	695	1591	33	0.003			0.20	1.19	1.39	
Mark Creek - Site 5	05/07/91	9.6	8.7	2460	18.5	20	196	255	429	445	1624	21	0.003			0.05	0.84	0.89	
Mark Creek - Site 5	06/11/91	8.1	8.3	2280	27.3	98	186	407	515	536	1505	134	0.003			0.70	0.52	1.22	
Mark Creek - Site 5	07/03/91	7.4	8.5	1988	22.5	24	160	359	828	447	1312	8	0.005			0.05	0.88	0.93	
Mark Creek - Site 5	07/18/91	9.2	8.0	1430	28.5	7	152	175	356	441	944	8	0.028			0.10	0.69	0.79	
Mark Creek - Site 5	08/19/91	9.0	8.2	630	28.6	12	102	65	131	169	416	54	0.050			0.50	0.81	1.31	
Mark Creek - Site 5	09/05/91	7.5	8.2	1185	26.5	51	100	97	668	570	782	8	0.220	0.005	0.02	0.26	0.50	0.76	0.02
Mark Creek - Site 5	10/03/91	9.4	8.3	1468	23.6	5	178	141	199	466	969	1	0.005	0.005	0.01	0.03	0.30	0.33	0.02
Mark Creek - Site 5	11/05/91			1580		12	202	116	757	900	1043	18	0.030	0.030	0.01	0.52	0.50	1.02	0.16
Mark Creek - Site 5	12/10/91	11.8	9.0	2540	9.2	22	193	420	472	710	1676		0.050	0.020	0.01	0.28	0.40	0.68	0.03
Mark Creek - Site 5	01/16/92	12.5	9.0	2770	0.4	47	270	500	488	760	1828	55	0.100	0.040	0.02	0.29	0.60	0.89	0.09
Mark Creek - Site 5	02/13/92			2530		32	260	410	495	700	1670	47	0.050	0.040	0.02	0.19	0.50	0.69	0.03
Mark Creek - Site 5	03/26/92	9.1	8.4	2530	20.3	17	176	433	578	780	1670	41	0.040	0.005	0.01	0.03	0.50	0.53	0.01
	Min.	7.4	7.4	630	0.0	3	100	35	131	169	416	1	0.003	0.005	0.01	0.03	0.11	0.29	0.01
	Max.	14.2	9.0	2770	28.6	98	270	500	828	915	1828	134	0.420	0.040	0.02	1.30	1.47	1.72	0.16
	Mean	10.1	8.4	1953	16.4	23	181	241	479	638	1289	32	0.053	0.021	0.01	0.31	0.63	0.94	0.05
	Median	9.8	8.4	2010	18.0	17	185	215	495	695	1327	23	0.022	0.020	0.01	0.25	0.52	0.93	0.03
Mark Creek - Site 4	10/02/90						147	52	248	354		12	0.003			1.20	0.42	1.62	
Mark Creek - Site 4	10/16/90	8.7	7.9	1623	13.7	5	153	46	635	930	1071	4	0.003			0.50	0.12	0.62	
Mark Creek - Site 4	11/07/90		8.3	207	22.9	9	211	85	697	447	137	13	0.539			0.25	0.45	0.70	
Mark Creek - Site 4	11/20/90	9.3	8.3	2250	14.3		176	219	790	587	1485	23	0.020			0.50	0.24	0.74	
Mark Creek - Site 4	12/04/90	13.2	8.2	2480	3.0	12	200	285	660	921	1637	36	0.047			0.40	0.50	0.90	
Mark Creek - Site 4	01/03/91	13.0	7.4	2490	2.0	3	272	182	690	1406	1643	5	0.003			0.90	0.56	1.46	
Mark Creek - Site 4	02/05/91	11.2	8.4	2380	8.9	32	213	363	420	792	1571	60	0.018			0.20	1.01	1.21	
Mark Creek - Site 4	03/05/91	11.7	8.3	2520	14.5	11	175	341	265	717	1663	28	0.022			0.05	1.01	1.06	
Mark Creek - Site 4	04/02/91	10.2	8.6	2670	13.1	12	180	412	734	734	1762	28	0.003			0.20	1.18	1.38	
Mark Creek - Site 4	05/07/91	9.3	8.7	2760	15.7	15	168	310	463	990	1822	26	0.012			0.05	0.69	0.74	
Mark Creek - Site 4	06/11/91	8.2	8.3	2380	24.5	95	184	421	515	521	1571	140	0.008			1.20	0.55	1.75	
Mark Creek - Site 4	07/03/91	7.4	8.2	2160	28.3	24	155	390	1002	497	1426	12	0.006			0.05	0.72	0.77	
Mark Creek - Site 4	07/18/91	5.6	8.0	1320	24.6	13	90	145	422	463	871	15	0.034			0.05	1.40	1.45	
Mark Creek - Site 4	08/19/91	6.7	8.5	612	24.3	16	139	42	139	213	404	2	0.031			0.60	0.79	1.39	
Mark Creek - Site 4	09/05/91	8.1	8.4	1377	23.9	49	94	63	596	520	909	35	0.090	0.005	0.01	0.08	0.50	0.58	0.03
Mark Creek - Site 4	10/03/91	8.5	8.1	1870	17.8	6	150	147	439	760	1234	1	0.010	0.005	0.01	0.34	0.30	0.64	0.01
Mark Creek - Site 4	11/05/91			1940		8	204	102	582	680	1280	15	0.030	0.030	0.01	0.68	0.50	1.18	0.15

Mark Creek - Site 4	12/10/91	12.6	9.0	2750	6.0	17	166	415	487	780	1815	25	0.060	0.010	<b>0.01</b>	0.26	0.30	0.56	0.02
Mark Creek - Site 4	01/16/92	13.0	8.5	2850	0.5	53	263	420	479	710	1881	56	0.120	0.040	0.02	0.25	0.50	0.75	0.06
Mark Creek - Site 4	02/13/92			2470		36	210	433	495	725	1630	48	0.020	0.020	0.01	0.13	0.40	0.53	0.01
Mark Creek - Site 4	03/26/92	8.7	8.2	2640	14.4	21	193	415	524	770	1742	27	0.030	<b>0.005</b>	<b>0.01</b>	0.10	0.30	0.40	0.01
	Min.	5.6	7.4	207	0.5	3	90	42	139	213	137	1	0.003	0.005	0.01	0.05	0.12	0.40	0.01
	Max.	13.2	9.0	2850	28.3	95	272	433	1002	1406	1881	140	0.539	0.040	0.02	1.20	1.40	1.75	0.15
	Mean	9.7	8.3	2087	15.1	23	178	252	537	691	1378	29	0.053	0.016	0.01	0.38	0.59	0.97	0.04
	Median	9.3	8.3	2380	14.5	15	176	285	515	717	1571	25	0.020	0.010	0.01	0.25	0.50	0.77	0.02
Mark Creek - Site 3	10/02/90						117	61	250	281		8	0.016			1.40	0.35	1.75	
Mark Creek - Site 3	10/16/90	9.7	8.1	2050	14.7	4	123	49	810	984	1353	4	<b>0.003</b>			<b>0.25</b>	0.14	0.39	
Mark Creek - Site 3	11/07/90		8.4	222	3.8	10	188	82	912	319	147	23	0.468			<b>0.25</b>	0.62	0.87	
Mark Creek - Site 3	11/20/90	9.9	8.4	2420	15.1		164	241	914	1084	1597	21	0.026			0.50	0.19	0.69	
Mark Creek - Site 3	12/04/90	13.8	8.2	2620	3.0	8	195	307	712	1010	1729	24	0.054			0.30	0.50	0.80	
Mark Creek - Site 3	01/03/91	13.0	7.5	2670	0.0	4	270	199	766	1584	1762	8	<b>0.003</b>			1.20	0.56	1.76	
Mark Creek - Site 3	02/05/91	10.8	8.4	2450	9.3	28	203	369	439	760	1617	58	0.028			0.20	0.98	1.18	
Mark Creek - Site 3	03/05/91	10.4	8.4	2510	15.5	14	173	341	267	717	1657	33	0.027			<b>0.05</b>	0.97	1.02	
Mark Creek - Site 3	04/02/91	10.0	8.7	2750	13.3	16	180	424	686	752	1815	29	<b>0.003</b>			0.20	1.28	1.48	
Mark Creek - Site 3	05/07/91	9.2	8.8	2790	16.9	15	193	363	483	986	1841	30	<b>0.003</b>			<b>0.05</b>	0.71	0.76	
Mark Creek - Site 3	06/11/91	8.4	8.4	2380	26.3	92	225	463	634	521	1571	67	0.009			0.90	0.56	1.46	
Mark Creek - Site 3	07/03/91	7.4	8.4	2250	23.1	24	195	396	942	511	1485	9	0.014			<b>0.05</b>	0.88	0.93	
Mark Creek - Site 3	07/18/91	6.6	8.1	2350	26.4	8	81	246	948	952	1551	10	0.029			<b>0.05</b>	0.79	0.84	
Mark Creek - Site 3	08/19/91	3.5	7.7	1782	25.9	8	95	240	982	581	1176	15	0.036			0.20	1.24	1.44	
Mark Creek - Site 3	09/05/91	8.0	8.3	1410	23.0	49	95	68	594	400	931	41	0.090	<b>0.005</b>	0.01	0.09	0.50	0.59	0.04
Mark Creek - Site 3	10/03/91	9.0	8.4	2260	21.3	8	110	180	727	930	1492	1	0.030	<b>0.005</b>	<b>0.01</b>	<b>0.03</b>	0.30	0.33	0.02
Mark Creek - Site 3	11/05/91			2080		9	184	60	418	620	1373	32	0.030	0.030	<b>0.01</b>	0.52	0.50	1.02	0.15
Mark Creek - Site 3	12/10/91	12.1	9.0	2780	8.5	18	172	450	426	750	1835	33	0.030	0.010	0.02	0.22	0.30	0.52	0.02
Mark Creek - Site 3	01/16/92	13.1	9.2	2950	0.5	46	275	280	170	570	1947	62	0.050	0.030	0.01	0.25	0.50	0.75	0.05
Mark Creek - Site 3	02/13/92			2260		40	206	450	483	750	1492	41	0.050	0.010	0.01	0.10	0.30	0.40	0.02
Mark Creek - Site 3	03/26/92	8.4	8.4	2710	18.1	16	175	303	510	740	1789	42	0.030	<b>0.005</b>	0.01	<b>0.03</b>	0.40	0.43	0.03
	Min.	3.5	7.5	222	0.0	4	81	49	170	281	147	1	0.003	0.005	0.01	0.03	0.14	0.33	0.02
	Max.	13.8	9.2	2950	26.4	92	275	463	982	1584	1947	67	0.468	0.030	0.02	1.40	1.28	1.76	0.15
	Mean	9.6	8.4	2285	14.7	22	172	265	623	752	1508	28	0.049	0.014	0.01	0.33	0.60	0.92	0.05
	Median	9.7	8.4	2400	15.3	15	180	280	634	750	1584	29	0.029	0.010	0.01	0.20	0.50	0.84	0.03
Mark Creek - Site 1	09/13/90						196	16	56	198		6	0.090			0.26	0.37	0.63	

Mark Creek - Site 1	10/02/90						225	31	245	104		46	0.170			0.90	0.32	1.22	
Mark Creek - Site 1	10/16/90	10.3	8.3	596	13.3	7	224	13	79	318	393	18	0.033			0.60	0.23	0.83	
Mark Creek - Site 1	11/07/90		8.3	671	4.4	11	233	5	126	300	443	12	0.449			0.50	0.53	1.03	
Mark Creek - Site 1	11/20/90	10.0	8.5	641	15.0		232	14	61	340	423	6	0.158			0.70	0.19	0.89	
Mark Creek - Site 1	12/04/90	13.4	8.2	686	3.0	6	232	15	64	307	453	13	0.221			0.80	0.59	1.39	
Mark Creek - Site 1	01/03/91	14.2	7.8	702	0.0	3	223	17	73	305	463	3	0.005			1.10	0.34	1.44	
Mark Creek - Site 1	02/05/91	11.3	8.5	682	9.7	8	216	17	157	311	450	14	0.257			0.70	0.76	1.46	
Mark Creek - Site 1	03/05/91	10.4	8.4	686	15.5	14	173	5	116	273	453	19	0.090			0.20	1.14	1.34	
Mark Creek - Site 1	04/02/91	9.6	8.6	692	13.6	10	273	17	131	289	457	15	0.079			0.20	1.51	1.71	
Mark Creek - Site 1	05/07/91	9.3	8.4	678	18.3	5	246	256	95	287	447	9	0.099			0.50	0.77	1.27	
Mark Creek - Site 1	06/11/91	8.3	8.5	641	28.3	28	227	21	114	273	423	35	0.079			1.50	0.60	2.10	
Mark Creek - Site 1	07/03/91	7.2	8.4	549	22.4	33	210	14	100	230	362	4	0.095			0.05	0.69	0.74	
Mark Creek - Site 1	07/18/91	7.7	8.3	524	24.7	23	220	16	32	226	346	29	0.122			0.30	0.44	0.74	
Mark Creek - Site 1	08/19/91	7.6	8.1	506	23.1	16	239	11	24	211	334	17	0.086			4.20	0.79	4.99	
Mark Creek - Site 1	09/05/91	8.0	8.4	557	21.8	22	225	15	48	235	368	25	0.160	0.090	0.04	0.65	0.40	1.05	0.06
Mark Creek - Site 1	10/03/91	10.6	8.4	586		9	240	16	75	238	387								
Mark Creek - Site 1	11/05/91			660		9	230	16	91	284	436	52	0.100	0.090	0.01	0.82	0.40	1.22	0.20
Mark Creek - Site 1	12/10/91	11.9	8.9	673	7.3	8	228	18	75	298	444	29	0.090	0.090	0.03	0.74	0.30	1.04	0.15
Mark Creek - Site 1	01/16/92	12.0	8.7	710	0.4	12	244	19	112	322	469	18	0.090	0.060	0.01	0.95	0.30	1.25	0.14
Mark Creek - Site 1	02/13/92			718		5	213	14	31	228	474	8	0.110	0.070	0.02	0.70	0.30	1.00	0.08
Mark Creek - Site 1	03/26/92	8.8	8.4	684	18.8	16	311	19	131	330	451	18	0.140	0.120	0.04	0.49	0.40	0.89	0.11
	Min.	7.2	7.8	506	0.0	3	173	5	24	104	334	3	0.005	0.060	0.01	0.05	0.19	0.63	0.06
	Max.	14.2	8.9	718	28.3	33	311	256	245	340	474	52	0.449	0.120	0.04	4.20	1.51	4.99	0.20
	Mean	10.0	8.4	642	14.1	13	230	27	93	269	424	19	0.130	0.087	0.02	0.80	0.54	1.34	0.12
	Median	10.0	8.4	672	15.0	10	228	16	85	286	444	17	0.099	0.090	0.03	0.70	0.40	1.22	0.13
Mark Cr Site 1-Hi Flow	05/24/91												0.896			0.50	1.63	2.13	
Mark Cr Site 1-Hi Flow	06/03/91			209		95	112	11	169	158	138	3090	0.246			1.00	1.38	2.38	
Mark Cr Site 1-Hi Flow	06/26/91			421		1486	175	11	49	160	278	1350	0.031			0.05	6.42	6.47	
Mark Cr Site 1-Hi Flow	08/21/91			323				10	24	150	213	684	0.073			0.60	2.37	2.97	
Mark Cr Site 1-Hi Flow	09/18/91					1800		10	64	257		3390	0.089			0.10	1.14	1.24	
Mark Cr Site 1-Hi Flow	11/19/91			295				10	86	120	195	2180	1.500	0.180	0.02	0.28	4.20	4.48	0.15
Mark Cr Site 1-Hi Flow	12/20/91			425							281	264	1.100	0.320	0.11	0.53	4.40	4.93	0.50
Mark Cr Site 1-Hi Flow	04/20/92							14	71	270		89	0.440	0.280	0.07	0.58	1.70	2.28	0.36
Mark Cr Site 1-Hi Flow	06/27/92			315							208	968	0.580	0.280	0.09	0.48	3.00	3.48	0.25
Mark Cr Site 1-Hi Flow	08/16/92			142				90	3	130	94	2040	0.680	0.260	0.04	0.60	1.70	2.30	0.09

Mark Cr Site 1-Hi Flow	12/13/92			279				9	26	124	184	1300	0.730	0.100	0.17	0.52	2.30	2.82	0.12
	Min.			142	95	112	9	3	120	94	89	89	0.031	0.100	0.02	0.05	1.14	1.24	0.09
	Max.			425	1800	175	90	169	270	281	3390	1.500	0.320	0.17	1.00	6.42	6.47	0.50	
	Mean			301	1127	144	21	61	171	199	1536	0.579	0.237	0.08	0.48	2.75	3.23	0.25	
	Median			305	1486	144	11	57	154	201	1325	0.580	0.270	0.08	0.52	2.30	2.82	0.20	
	% Difference Btwn Hi & Lo Flow			-53%		8679%	-38%	-22%	-34%	-36%	-53%	8063%	346%	173%	245%	-41%	408%	140%	99%
Mark Creek - Site 2	10/16/90	9.7	8.2	511	12.6	11	232	11	133	254	337	19	0.031			0.80	0.73	1.53	
Mark Creek - Site 2	11/07/90		8.4	551	14.2	15	235	5	62	213	364	41	0.499			0.50	0.46	0.96	
Mark Creek - Site 2	11/20/90	9.3	8.4	521	14.9		228	13	14	342	344	13	0.179			0.60	1.09	1.69	
Mark Creek - Site 2	12/04/90	13.8	8.2	524	3.0	6	229	12	10	238	346	16	0.120			0.90	0.71	1.61	
Mark Creek - Site 2	01/03/91	13.8	7.8	520	0.0	3	212	12	20	228	343	6	0.003			0.90	0.34	1.24	
Mark Creek - Site 2	02/05/91	11.1	8.5	519	9.1	9	211	12	88	219	343	17	0.109			1.20	1.68	2.88	
Mark Creek - Site 2	03/05/91	10.7	8.4	512	13.9	6	207	5	55	202	338	9	0.072			0.50	1.52	2.02	
Mark Creek - Site 2	04/02/91	9.8	8.6	521	13.6	9	225	12	47	200	344	7	0.098			0.20	2.23	2.43	
Mark Creek - Site 2	05/07/91	8.7	8.6	552	17.0	6	237	267	10	234	364	12	0.111			0.70	4.91	5.61	
Mark Creek - Site 2	06/11/91	8.7	8.4	530	24.9	26	229	17	47	206	350	66	0.003			1.90	0.76	2.66	
Mark Creek - Site 2	07/03/91	7.4	8.5	485	21.9	39	218	364	137	202	320	56	0.050			0.05	0.85	0.90	
Mark Creek - Site 2	07/18/91	7.9	8.4	494	23.2	19	227	14	10	208	326	30	0.086			0.40	0.50	0.90	
Mark Creek - Site 2	08/19/91	8.0	8.6	490	23.5	24	228	10	10	211	323	58	0.087			0.80	0.57	1.37	
Mark Creek - Site 2	09/05/91	7.4	8.4	516	22.7	22	230	15	35	210	341	64	0.200	0.120	0.05	0.70	0.90	1.60	0.21
Mark Creek - Site 2	10/03/91	8.6	8.5		17.2			14	24	208		31	0.190	0.080	0.03	0.79	0.30	1.09	0.04
Mark Creek - Site 2	11/05/91			539		20	228	15	32	222	356	27	0.480	0.260	0.01	0.89	2.40	3.29	0.34
Mark Creek - Site 2	12/10/91	11.4	8.9	533	7.0	6	250	18	25	216	352	2	0.080	0.080	0.02	0.83	0.30	1.13	0.11
Mark Creek - Site 2	01/16/92	12.5	9.0	525	0.3	7	233	15	30	250	347	18	0.050	0.040	0.01	1.00	0.20	1.20	0.09
Mark Creek - Site 2	02/13/92			530		18	212	19	109	328	350	20	0.520	0.310	0.02	0.86	1.60	2.46	0.25
Mark Creek - Site 2	03/26/92	9.3	8.6	518	18.5	9	216	18	32	260	342	14	0.410	0.260	0.04	0.58	1.60	2.18	0.45
	Min.	7.4	7.8	485	0.0	3	207	5	10	200	320	2	0.003	0.040	0.01	0.05	0.20	0.90	0.04
	Max.	13.8	9.0	552	24.9	39	250	364	137	342	364	66	0.520	0.310	0.05	1.90	4.91	5.61	0.45
	Mean	9.9	8.5	521	14.3	14	226	43	47	233	344	26	0.169	0.164	0.03	0.76	1.18	1.94	0.21
	Median	9.3	8.5	521	14.6	10	228	14	32	218	344	19	0.104	0.120	0.02	0.80	0.80	1.60	0.21

APPENDIX B

BACTERIOLOGICAL DATA:  
MARK CREEK PROJECT

Site	WBID#	Lab	Date	FC / MF	FS / MF
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	10/02/90	4200	2200
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	10/15/90	680	130
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	11/07/90	1000	1800
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	11/20/90	1900	2300
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	12/04/90	1800	620
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	01/03/91	200	100
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	02/05/91	300	1200
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	03/05/91	170	1545
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	04/02/91	1500	3000
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	05/07/91	280	1
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	05/30/91	7400	1
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	06/11/91	710	300
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	06/20/91	290	490
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	07/03/91	1140	5200
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	07/18/91	2600	1800
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	08/06/91	400	820
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	08/19/91	1200	3500
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	09/05/91	<b>800</b>	450
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	09/17/91	830	1000
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	10/03/91	900	800
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	12/10/91	70	180
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	01/16/92	40	40
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	02/13/92	1100	500
Mark Creek Site - 1 (ISCO)	OK520620-01-0137G	OSH D	03/26/92	160	90
			<b>MEAN</b>	1236	1169
			<b>MEDIAN</b>	815	710
			<b>GEO MEAN</b>	645	393

			All Samples	May-Sep.	
	% > 200/100 ml		79%	100%	
	% > 400/100 ml		67%	80%	
	% > 2000/100 ml		13%	20%	
Mark Creek Site - 2	OK520620-01-0137V	OSH D	10/15/90	1200	130
Mark Creek Site - 2	OK520620-01-0137V	OSH D	11/07/90	2000	1900
Mark Creek Site - 2	OK520620-01-0137V	OSH D	11/20/90	450	450
Mark Creek Site - 2	OK520620-01-0137V	OSH D	12/04/90	2800	2500
Mark Creek Site - 2	OK520620-01-0137V	OSH D	01/03/91	300	300
Mark Creek Site - 2	OK520620-01-0137V	OSH D	02/05/91	3900	2800
Mark Creek Site - 2	OK520620-01-0137V	OSH D	03/05/91	5700	3300
Mark Creek Site - 2	OK520620-01-0137V	OSH D	04/02/91	6000	3000
Mark Creek Site - 2	OK520620-01-0137V	OSH D	05/07/91	600	720
Mark Creek Site - 2	OK520620-01-0137V	OSH D	05/30/91	45000	1
Mark Creek Site - 2	OK520620-01-0137V	OSH D	06/11/91	7500	4500
Mark Creek Site - 2	OK520620-01-0137V	OSH D	06/20/91	1500	1300
Mark Creek Site - 2	OK520620-01-0137V	OSH D	07/03/91	2300	4000
Mark Creek Site - 2	OK520620-01-0137V	OSH D	07/18/91	2500	2400
Mark Creek Site - 2	OK520620-01-0137V	OSH D	08/06/91	640	4400
Mark Creek Site - 2	OK520620-01-0137V	OSH D	08/19/91	1600	1700
Mark Creek Site - 2	OK520620-01-0137V	OSH D	09/05/91	<b>800</b>	1400
Mark Creek Site - 2	OK520620-01-0137V	OSH D	09/17/91	1000	1000
Mark Creek Site - 2	OK520620-01-0137V	OSH D	10/03/91	1800	1800
Mark Creek Site - 2	OK520620-01-0137V	OSH D	12/10/91	40	40
Mark Creek Site - 2	OK520620-01-0137V	OSH D	01/16/92	110	80
Mark Creek Site - 2	OK520620-01-0137V	OSH D	02/13/92	<b>15000</b>	<b>15000</b>
Mark Creek Site - 2	OK520620-01-0137V	OSH D	03/26/92	7000	2000

			<b>MEAN</b>	4771	2379
			<b>MEDIAN</b>	1800	1800
			<b>GEO MEAN</b>	1676	926
			<b>All Samples</b>		<b>May- Sep.</b>
	<b>% &gt; 200/100 ml</b>		92%	100%	
	<b>% &gt; 400/100 ml</b>		87%	100%	
	<b>% &gt; 2000/100 ml</b>		48%	40%	
Canadian River Site - 3	OK520620-01-0010S	OSH D	10/02/90	30	2800
Canadian River Site - 3	OK520620-01-0010S	OSH D	10/15/90	700	30
Canadian River Site - 3	OK520620-01-0010S	OSH D	11/07/90	780	120
Canadian River Site - 3	OK520620-01-0010S	OSH D	11/20/90	100	240
Canadian River Site - 3	OK520620-01-0010S	OSH D	12/04/90	50	100
Canadian River Site - 3	OK520620-01-0010S	OSH D	01/03/91	1	100
Canadian River Site - 3	OK520620-01-0010S	OSH D	02/05/91	1	1
Canadian River Site - 3	OK520620-01-0010S	OSH D	03/05/91	1	30
Canadian River Site - 3	OK520620-01-0010S	OSH D	04/02/91	10	100
Canadian River Site - 3	OK520620-01-0010S	OSH D	05/07/91	20	50
Canadian River Site - 3	OK520620-01-0010S	OSH D	05/30/91	100	1
Canadian River Site - 3	OK520620-01-0010S	OSH D	06/11/91	80	80
Canadian River Site - 3	OK520620-01-0010S	OSH D	06/20/91	10	20
Canadian River Site - 3	OK520620-01-0010S	OSH D	07/03/91	10	30
Canadian River Site - 3	OK520620-01-0010S	OSH D	07/18/91	20	20
Canadian River Site - 3	OK520620-01-0010S	OSH D	08/06/91	1	310
Canadian River Site - 3	OK520620-01-0010S	OSH D	08/19/91	80	410
Canadian River Site - 3	OK520620-01-0010S	OSH D	09/05/91	560	220
Canadian River Site - 3	OK520620-01-0010S	OSH D	09/17/91	260	180
Canadian River Site - 3	OK520620-01-0010S	OSH D	10/03/91	30	1
Canadian River Site - 3	OK520620-01-0010S	OSH	12/10/91	50	70



		D			
Canadian River Site - 3	OK520620-01-0010S	OSH D	01/16/92	1	50
Canadian River Site - 3	OK520620-01-0010S	OSH D	02/13/92	1100	310
Canadian River Site - 3	OK520620-01-0010S	OSH D	03/26/92	10	30
			<b>MEAN</b>	167	221
			<b>MEDIAN</b>	30	75
			<b>GEO MEAN</b>	28	55
			<b>All Samples</b>	<b>May- Sep.</b>	
	<b>% &gt; 200/100 ml</b>		21%	20%	
	<b>% &gt; 400/100 ml</b>		17%	10%	
	<b>% &gt; 2000/100 ml</b>		0%	0%	
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	10/02/90	350	1400
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	10/15/90	1700	80
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	11/07/90	2600	1600
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	11/20/90	450	700
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	12/04/90	160	200
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	01/03/91	100	1
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	02/05/91	1	1
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	03/05/91	1	190
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	04/02/91	10	150
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	05/07/91	30	10
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	05/30/91	500	1
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	06/11/91	240	140
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	06/20/91	50	40
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	07/03/91	20	150
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	07/18/91	70	5100
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	08/06/91	70	80
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	08/19/91	290	440

Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	09/05/91	510	250
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	09/17/91	250	250
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	10/03/91	110	80
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	12/10/91	10	60
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	01/16/92	10	40
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	02/13/92	800	200
Canadian River below Mark Cr. Site - 4	OK520620-01-0010P	OSH D	03/26/92	20	30
			<b>MEAN</b>	348	466
			<b>MEDIAN</b>	105	145
			<b>GEO MEAN</b>	83	90
			<b>All Samples</b>	<b>May- Sep.</b>	
	<b>% &gt; 200/100 ml</b>		21%	20%	
	<b>% &gt; 400/100 ml</b>		17%	10%	
	<b>% &gt; 2000/100 ml</b>		0%	0%	
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	10/02/90	1	200
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	10/15/90	10	1
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	11/07/90	390	800
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	11/20/90	450	1000
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	12/04/90	10	330
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	01/03/91	100	200
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	02/05/91	1	800
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	03/05/91	20	120
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	04/02/91	10	250
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	05/07/91	1	20
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	05/30/91	700	1
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	06/11/91	210	150
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	06/20/91	50	30
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH	07/03/91	<b>10</b>	20

		D			
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	07/18/91	10	180
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	08/06/91	350	550
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	08/19/91	1	20
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	09/05/91	530	350
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	09/17/91	230	160
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	10/03/91	10	20
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	12/10/91	640	220
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	02/13/92	1300	2100
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	01/16/92	1	140
Canadian River Groendyke Site - 5	OK520620-01-0010K	OSH D	03/26/92	50	30
			<b>MEAN</b>	212	321
			<b>MEDIAN</b>	35	170
			<b>GEO MEAN</b>	34	103
			<b>All Samples</b>	<b>May- Sep.</b>	
			<b>% &gt; 200/100 ml</b>	38%	50%
			<b>% &gt; 400/100 ml</b>	21%	20%
			<b>% &gt; 2000/100 ml</b>	0%	0%
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	10/02/90	40	100
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	10/15/90	20	1
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	11/07/90	600	750
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	11/20/90	400	180
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	12/04/90	1	20
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	01/03/91	1	200
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	02/05/91	100	200
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	03/05/91	1	70
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	04/02/91	10	10
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	05/07/91	1	1

Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	05/30/91	250	1
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	06/11/91	140	50
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	06/20/91	10	10
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	07/03/91	<b>10</b>	650
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	07/18/91	<b>10</b>	20
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	08/06/91	30	60
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	08/19/91	1	1
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	09/05/91	<b>800</b>	650
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	09/17/91	1500	1200
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	10/03/91	10	10
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	12/10/91	520	220
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	01/16/92	1	110
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	02/13/92	240	1400
Canadian River Bridgeport Site - 6	OK520620-01-0100G	OSH D	03/26/92	10	50
			<b>MEAN</b>	196	249
			<b>MEDIAN</b>	15	65
			<b>GEO MEAN</b>	25	49
			<b>All Samples</b>		<b>May- Sep.</b>
	<b>%fc &gt; 200/100 ml</b>		29%	30%	
	<b>%fc &gt; 400/100 ml</b>		21%	20%	
	<b>%fc &gt; 2000/100 ml</b>		0%	0%	
<b>BOLD = &lt; OR &gt; THE LISTED VALUE</b>					
1 = NONE DETECTED					