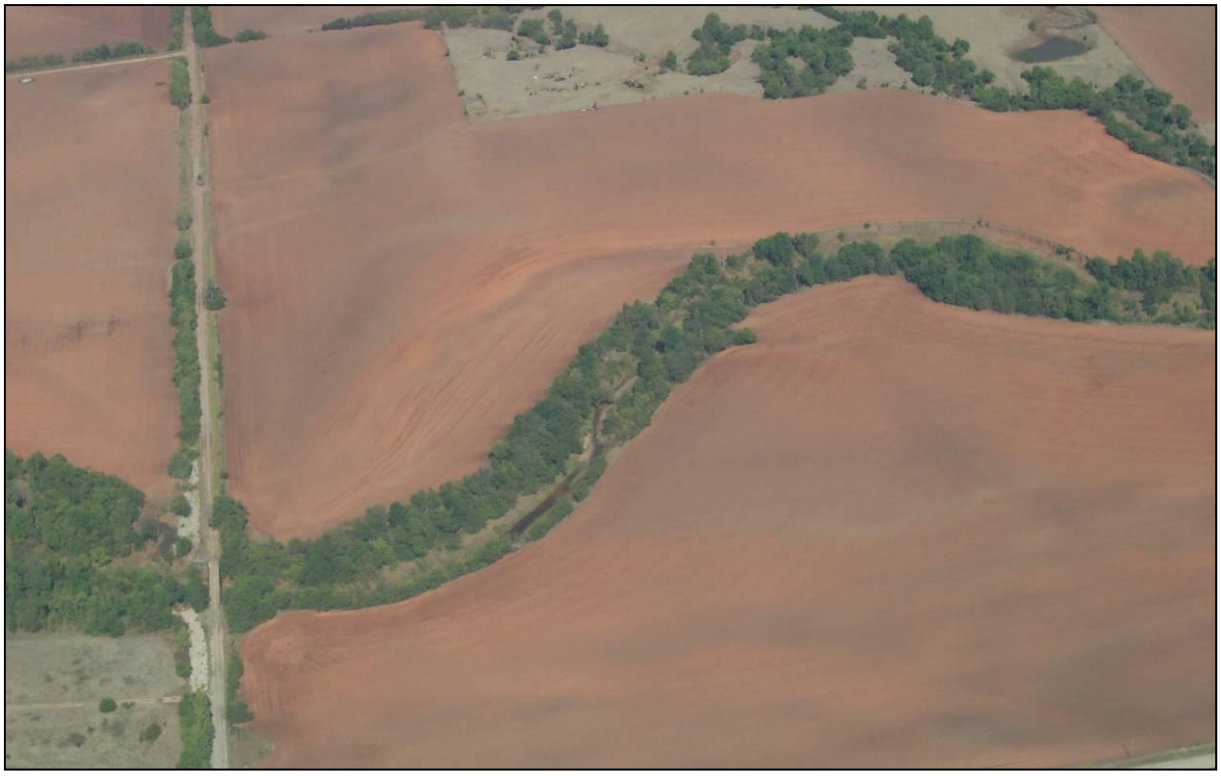
Black Bear Creek
Watershed Management Plan



Prepared by
Pawnee Nation Department of Environmental Conservation and Safety
CWA§319 Nonpoint Source Pollution Project
2012

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*Cover Photo by Kelton Kersey Upper Black Bear Creek in Noble County during a fly over of the watershed in 2006.

ACRONYMS AND ABBREVIATIONS

303(d) 2010 Oklahoma Integrated Report 303(d) List of Impaired Waters Draft
BBCW Black Bear Creek Watershed
BIA Bureau of Indian Affairs
BLM Bureau of Land Management
BMPs Best Management Practices
CWAP Clean Water Action Plan
DOI Department of Interior
DO Dissolved Oxygen
EPA United States Environmental Protection Agency
IHS Indian Health Service
OCC Oklahoma Conservation Commission
OK Corp Commission Oklahoma Corporation Commission
ODEQ Oklahoma Department of Environmental Quality
OSE Office of the Secretary of the Environment
OKWBID Oklahoma Waterbody Identification number
OWRB Oklahoma Water Resources Board
PNDECS Pawnee Nation Department of Environmental Conservation and Safety
PNDNRS Pawnee Nation Division of Natural Resources and Safety
TMDL Total Maximum Daily Load
UWA Unified Watershed Assessment
WBP Watershed Based Plan

PREFACE

The Black Bear Creek Watershed (BBCW) is a major catchment for the Arkansas River and covers approximately 663 square miles, 424,320 acres, in north central Oklahoma. The Oklahoma Department of Environmental Quality (ODEQ) has categorized thirty six Oklahoma Waterbody Identification number (OKWBID) streams within the BBCW. These named streams total approximately 360 linear miles. Five OKWBID lakes totaling approximately 1,439 acres and numerous unnamed tributaries are located within the watershed. Portions of Black Bear Creek and its tributaries Camp Creek, Cow Creek, Gansel Creek, Garber Creek, Garber Field, Lutheran, St. John, and Shale are listed on the draft 2010 Oklahoma Integrated Report 303(d) List of Impaired Waters Draft (303(d)). Lone Chimney Lake, Pawnee Lake, and Perry Lake are also listed on the 303(d) List of Impaired Waters (Appendix 1). The 303(d) listed waters within the BBCW account for 139.2 linear stream miles (38.7%) and 1,421 surface water acres (98.7%) within the BBCW. All of these listed waters are either Category 5a or 5c. Category 5a waters have a Total Maximum Daily Load (TMDL) underway or to be scheduled. A "Turbidity Total Maximum Daily Load for Black Bear Creek, Oklahoma (621200030010_00)" Final was released in August 2010 by the ODEQ (ODEQ 2010). This accounts for the eastern 68 miles of the downstream portion of Black Bear Creek before its confluence with the Arkansas River. Category 5c waters require additional data and information that will be collected before a TMDL or review of the water quality standards is scheduled. The purpose of this watershed management report is to establish a plan that reduces watershed impairments through nonpoint source (NPS) best management practices (BMPs) and stream restoration.

Table 1. 2010 Impairment Causes for Streams of Black Bear Creek Watershed (ODEQ 2010).

Stream or Lake	OKWID#	Length (miles) or Area (acres)	Turbidity	Pathogen	Biological Assessment	Low Dissolved Oxygen	Chl-a	Color	Chloride	Lead	Thallium	Sulfates	Total Dissolved Solids
Black Bear (lower)	OK621200030010	68.02	X	X	X					X	X		
Black Bear (Upper)	OK621200030260	11.65							X				X
Camp Creek	OK621200030040	23.09			X								
Cow Creek	OK621200030270	12.97		X									
Gansel Creek	OK621200030360	7.36							X			X	X
Lucien Creek	OK621200030396	3.62							X			X	X
Garber Creek	OK621200030420	5.62							X			X	X
Garber Field	OK621200030490	3.42							X				X
St. John Creek	OK621200030500	2.58							X				X
Shale Creek	OK621200030510	2.54							X				X
Lutheran Creek	OK621200030560	2.76							X				X
Lone Chimney Lake	OK621200030060	550				X							
Pawnee Lake	OK621200030100	257	X				X	X					
Perry Lake	OK621200030350	614	X					X					

INTRODUCTION

In 1997, a nationwide strategy to protect water quality was initiated, which resulted in the development of the *Clean Water Action Plan* (CWAP). The CWAP established goals and implementation schedules for numerous strategies dealing with point and nonpoint sources. Oklahoma's Office of the Secretary of the Environment (OSE) was designated as the state lead agency to implement the provisions of the CWAP in Oklahoma. The Pawnee Nation Department of Environmental Conservation and Safety is the lead agency in Pawnee Indian Country for the implementation of the environmental goals and objectives of the Pawnee Nation. In 1996 the Pawnee Nation Business Council established the DECS by enacting then Article 10 of the Pawnee Nation Law and Order Code. Today the DECS operates under Article 13 Natural Resource Protection Act. The Pawnee Nation established their Nonpoint Source Pollution Program under section 319 of the Clean Water Act in 2005 with the development and approval a nonpoint source pollution assessment and management plan. The assessment consisted of an assessment and overview of the waters of the Pawnee Nation, while the management plan identified any best management practices to be implemented.

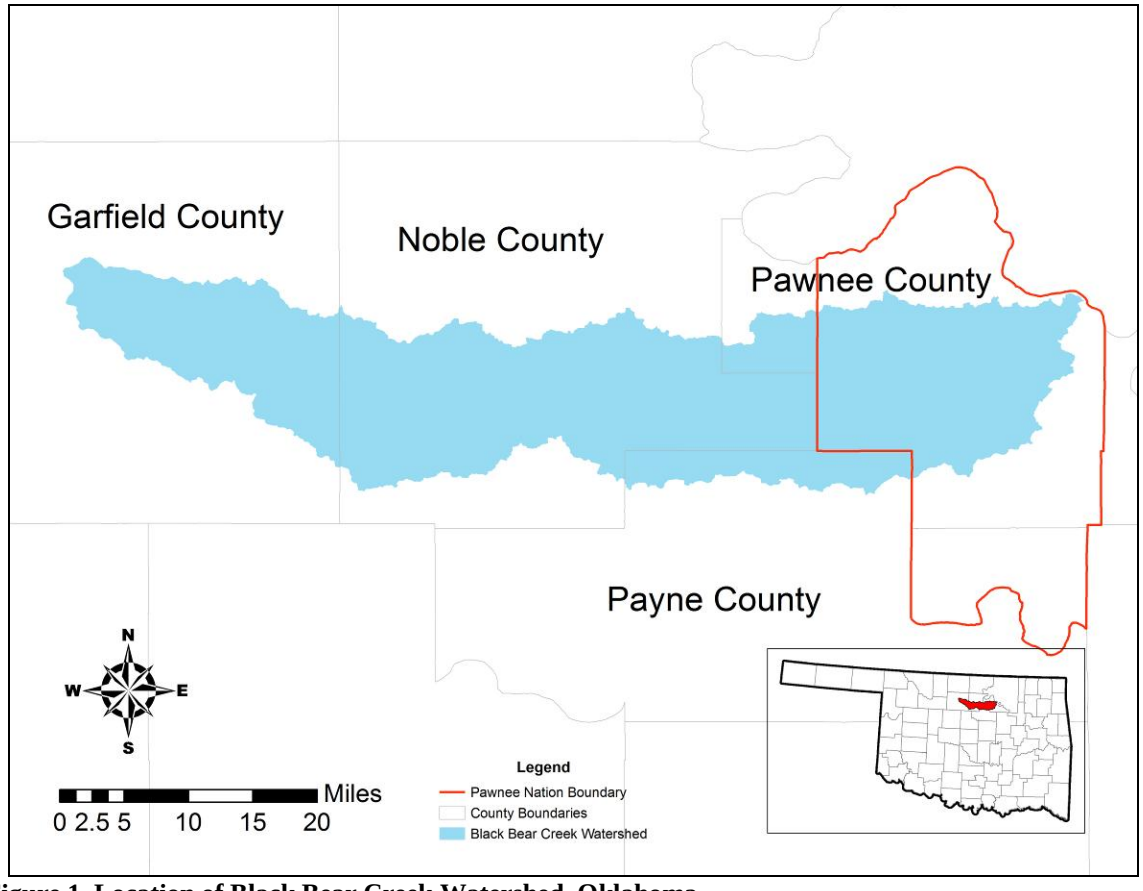

Figure 1. Location of Black Bear Creek Watershed, Oklahoma.

The United States Environmental Protection Agency (EPA) 1986 Inventory Report to Congress ranked nonpoint sources (NPS) of pollution, such as runoff from agricultural areas, as the leading contributors of pollution to lakes, streams, and estuaries (EPA, 1987). Controlling nonpoint sources of pollution is rapidly becoming a national priority in environmental quality management. Due to the magnitude of the area and diversity of land use practices within each regulatory region across the U.S, prioritization and targeting of NPS pollution sources is necessary for effective implementation of remediation or restoration programs.

To implement a thorough NPS Program a watershed based plan should be developed. The Watershed Management Planning guidance defines the 9 key components to be addressed in a watershed based plan, much of which builds from the strategies outlined in the *Watershed Restoration Action Strategy*. These components include:

1) identification of causes and sources that will need to be controlled to achieve load reductions,
2) estimate of load reductions expected from the management measures described,
3) a description of the management measures that will need to be implemented to achieve load reductions
4) an estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources or authorities who will bear responsibility,
5) an information/education component that will be used to enhance public understanding of the project and encourage early participation in the overall program,
6) a schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious,
7) a description of interim, measurable milestones for determining whether control actions are being implemented,
8) a set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made or whether the Watershed Plan or Total Maximum Daily Load (TMDL) needs to be revised and,
9) a monitoring component to evaluate the effectiveness of the implementation efforts over time.

In order for the WBP to become an integral part of the entire watershed restoration program, it must be amenable to revision and update. The Black Bear Creek WBP has been developed as a dynamic document that will be revised to incorporate the latest information, address new strategies, and define new partnerships between watershed shareholders. It is anticipated that at least biannual revisions may be necessary and that the responsibility for such revisions will rest primarily with the Pawnee Nation DECS, with support from the NPS Working Group. It is understood that the water quality goals set forth in this WBP, as well as the technical approach to address the goals, may not be comprehensive, so they may be expanded in the future. Federal and state funding allocations for future water quality projects designed to address the Black Bear Creek Watershed problems should not be based solely upon their inclusion in this WBP; rather, the WBP should be considered a focal point for initial planning and strategy development.

WATERSHED CHARACTERIZATION

The Black Bear Creek Watershed covers approximately 171,703 hectares in north central Oklahoma and drains east for approximately 80 miles before its confluence with The Arkansas River. Black Bear Creek's headwaters begin in Garfield County, flow east through Noble County to the Pawnee Nation and Pawnee County. The northern portion of Payne County also lies within the BBCW boundary. The BBCW comprises the Oklahoma 8-digit Planning Basin 621200_03. The major tributaries to Black Bear Creek include Camp Creek, Long Branch, Cow Creek, Panther Creek, and Warren Creek.

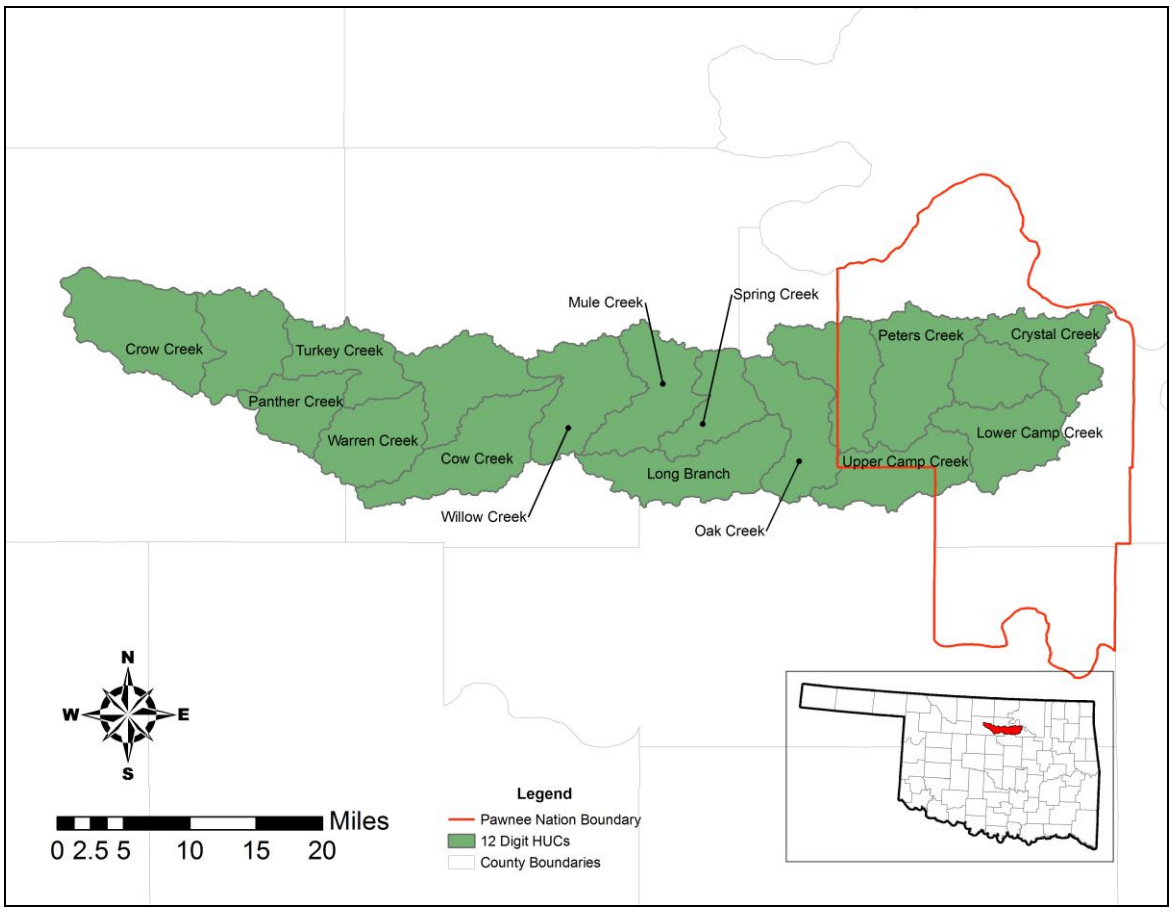

Figure 2. The 12 Digit HUC Sub-Watersheds of Black Bear Creek.

Physical/Natural Features

The BBCW is dominated by the Central Great Plains level III ecoregion (99.7%). This ecoregion consists primarily of croplands converted from grasslands with scattered low trees and shrubs. Subsurface salt deposits and leaching contribute to high salinity levels found in some streams. A minor portion (0.3%) of the Cross Timbers level III ecoregion is located in the central southern

portion of the watershed. This ecoregion is a transition area between the Central Great Plains and the forested low mountains or hills of eastern Oklahoma and Texas.

The BBCW contains three Level IV Ecoregions known as Cross Timbers Transition, Northern Cross Timbers, and Prairie Tableland. The Cross Timbers Transition ecoregion represents the majority of BBCW (81.1%) and consists of rocky plains that are sometimes broken and incised by streams with rocky or muddy substrates.

The superficial geology is mantled by Quaternary alluvium, terrace deposits, and decomposition residuum of fine sandy loam, clayey silt, sandy clay loam, silty clay, and clayey loam textures (Figure 3). The bedrock geology consists of Permian and Pennsylvanian age sandstone and shale as well as some limestone and mudstone conglomerates.

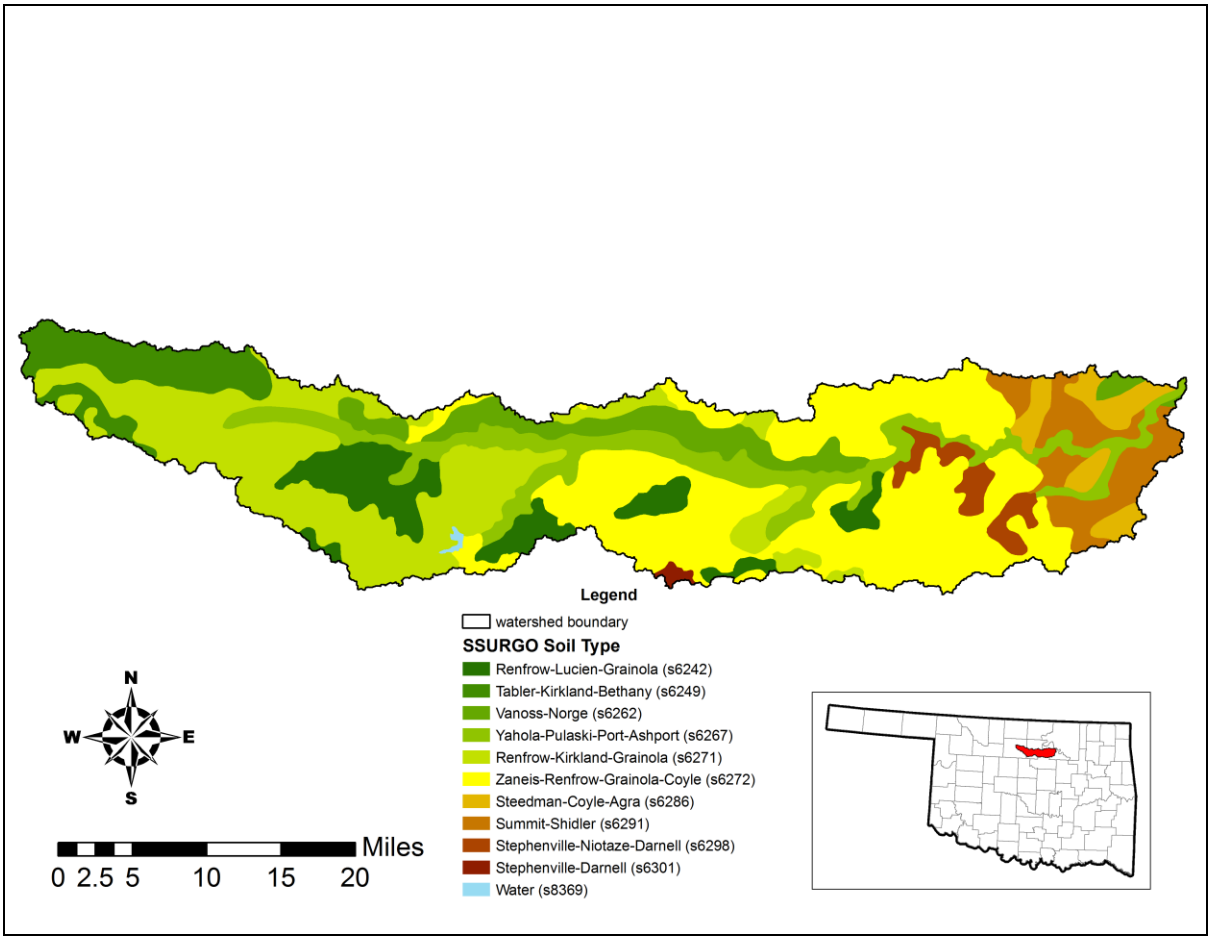

Figure 3. Soils map of Black Bear Creek Watershed.

The mean annual precipitation for this ecoregion is 29-38 inches with the rainfall increasing eastward. Natural vegetation consists of mixed grass prairies, cross timbers, and tall grass prairies. The Prairie Tableland ecoregion (18.6%) contains level to slightly rolling plains with broad, flat interfluves and low gradient, broad, shallow, and sand or silt choked stream channels. These channels contain short reaches with gravel, cobble, or bedrock substrates. Stream channels in this ecoregion usually flow strongly after rains, have high suspended sediment concentrations, and go dry in the late summer. Geological, annual precipitation and natural vegetation conditions are similar to the Cross Timbers Transition ecoregion.

A minor portion of BBCW contains the Northern Cross Timbers ecoregion (0.3%) which is very similar in vegetation and geology to the Cross Timbers Transition and Prairie Tableland ecoregions. Differences include a higher mean annual precipitation of 36-46 inches and more defined topographical features such as cuestas, ridges, and ledges (Woods et al, 2005).

Land Use

The BBCW consists primarily of pasture/rangeland (53.2%) and planted/cultivated areas (24%).The majority of crops planted within the watershed include corn, soybean, wheat, and milo. Land Use distributions for BBCW are located in Table 2.

Table 2. Land Use distribution within the Black Bear Creek Watershed.

Class	Hectares	Percentage of Class in Watershed
Water	6750	1.4
Developed	8095	4.7
Deciduous forest	21425	13.8
Mixed Forest	869	0.5
Conifer Forest	635	0.4
Planted/Cultivated	40912	24.0
Pasture/Rangeland	89731	53.2
Clouds	3286	1.9
Total	171703	100

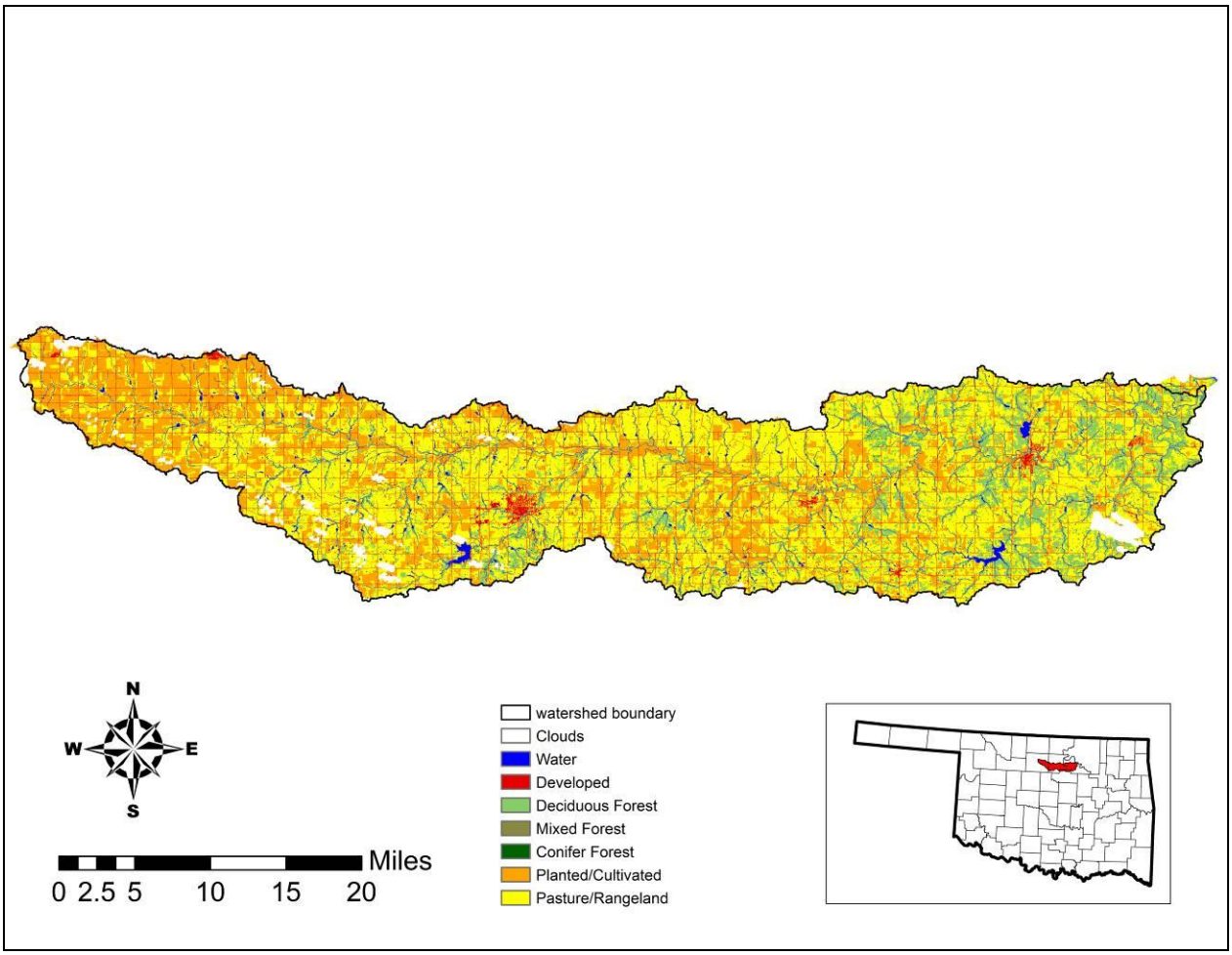

Figure 4. Land Use Map of Black Bear Creek Watershed.

Human Population

Developed land within the BBCW consists of 4.7 percent of the total watershed. The two major municipalities within the BBCW are Perry and Pawnee with populations of 5,230 and 2,230 respectively. The smaller towns of Garber, Morrison, and Glencoe exist within the BBCW and contribute a combined population of 2,064. The total population within the BBCW is approximately 9,524 according to the 2000 Census (http://factfinder.census.gov).

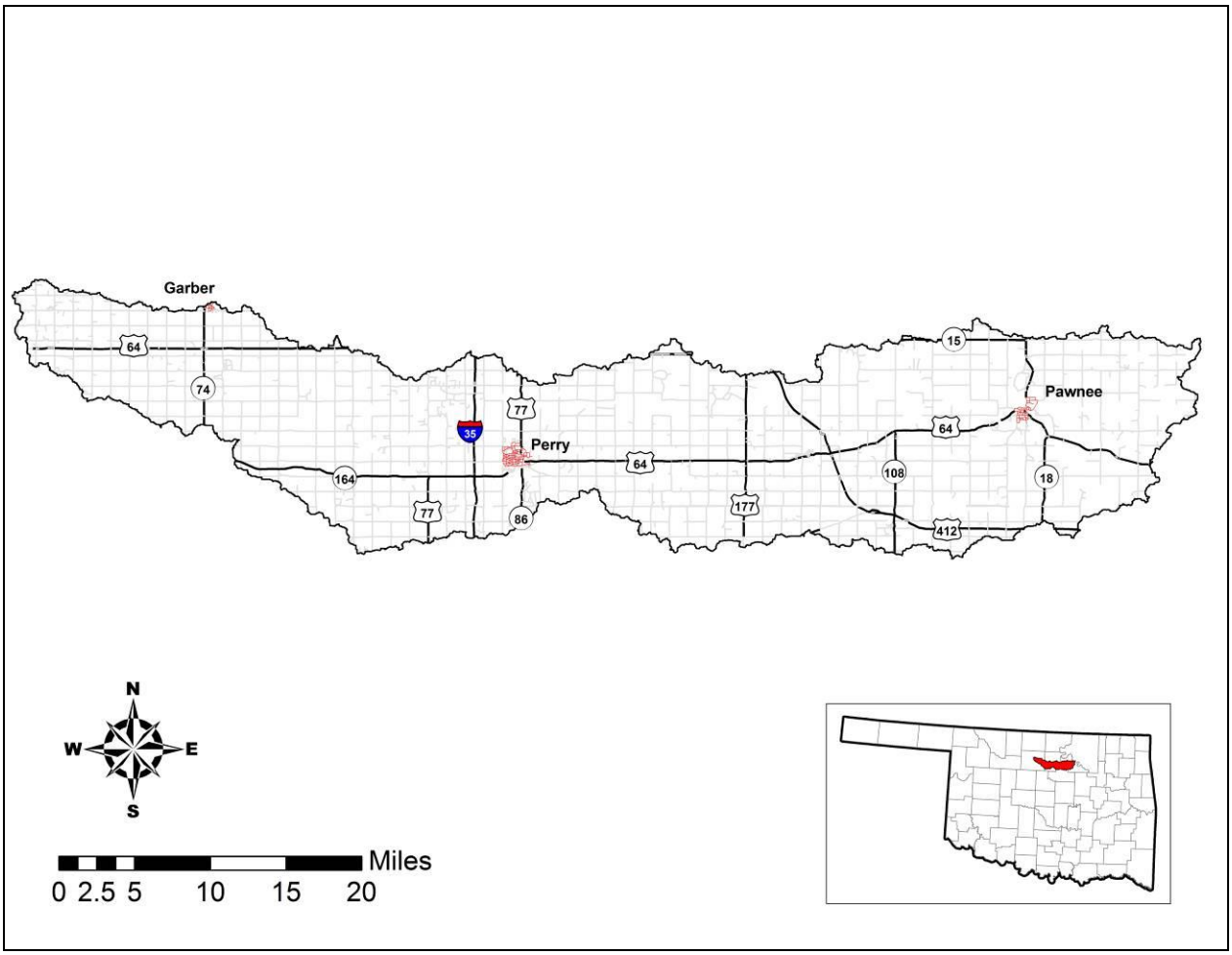

Figure 5. Road map of Black Bear Creek Watershed with urban area roads in red, state and federal highways in black, and county roads in grey.

Source Water Protection Areas

Source water protection areas within the BBCW include three drinking water supply lakes, Lone Chimney, Pawnee Lake and Perry Lake, as well as the drinking water wells of the Pawnee Nation. Lone Chimney Lake is tributary of Camp Creek, Pawnee Lake is a tributary of Skedee Creek and Perry Lake is a tributary of Cow Creek. A low water dam was installed on Black Bear Creek for the use as an emergency water supply for the City of Pawnee.

Source water studies conducted by the Pawnee Nation and the Bureau of Land Management conclude Black Bear Creek is included in the Area of Concern for the Pawnee Nation's public supply wells and any water quality issues in Black Bear Creek may also impact the quality of water in the supply wells. Under increased flow conditions and associated higher water levels, the source of the wells are likely to have hydraulic connectivity with Black Bear Creek anywhere

within the influence zone of the wells, then Black Bear Creek could potentially impact the supply wells.

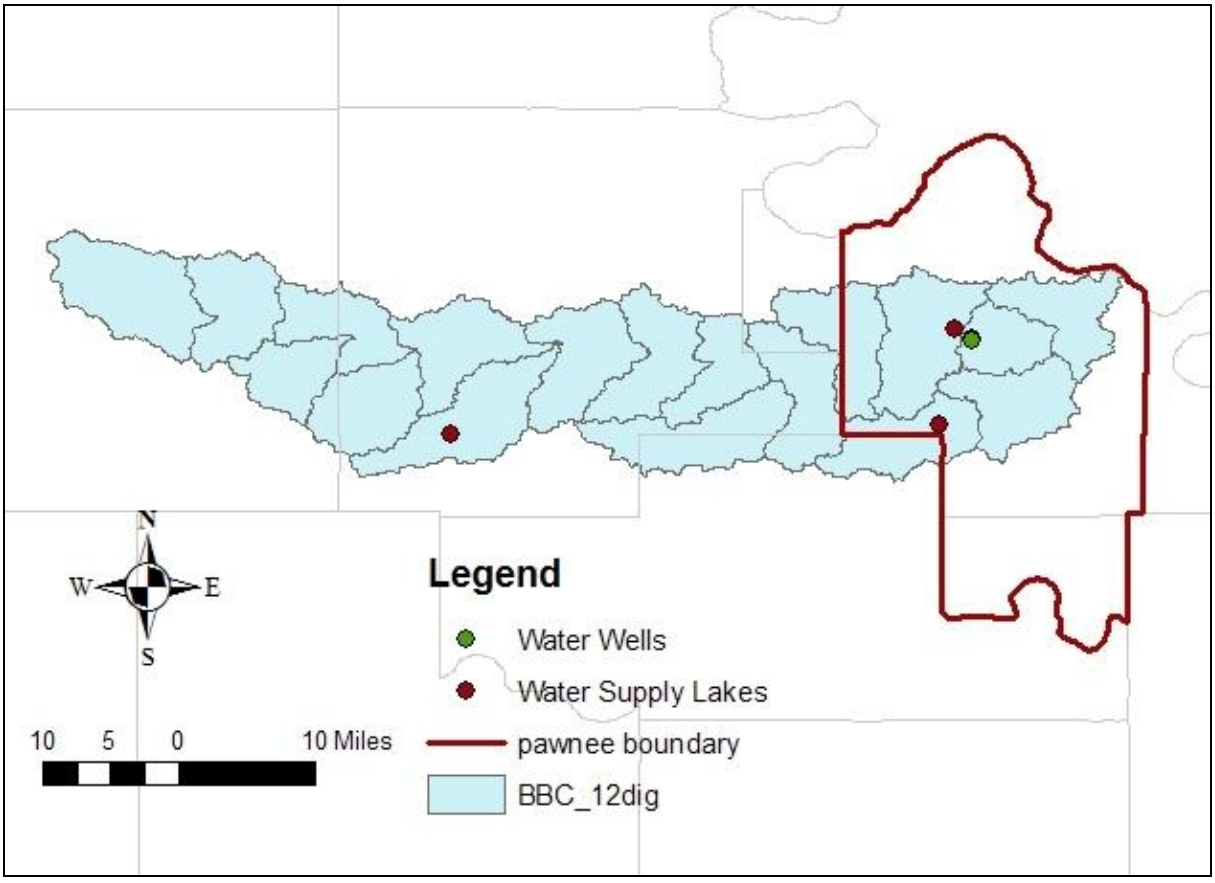

Figure 6. Drinking water supply lakes and Pawnee Nation groundwater wells.

WATERBODY CONDITIONS

Data of water quality of the Black Bear Creek Watershed has been collected by both the State of Oklahoma and the Pawnee Nation Department of Environmental Conservation and Safety. The Pawnee Nation has collected seven years of monthly data including chemical, physical and biological parameters. All chemical data has been collected using approved USEPA procedures and submitted to the STORET/WQX database. The following is a summarization of the chemical and biological aspects of the watershed as monitored by the Pawnee Nation.

Flow:

Flow of Black Bear Creek is influenced by rainfall within the watershed. Flow or discharge is monitored by a USGS gauging station at the highway 18 bridge in the city of Pawnee. Discharge is recorded and the data is managed by the USGS. Flow measurements are recorded during sampling events by the Pawnee Nation. The flow ranges from less than 10 cubic feet per second (CFS) to over 2000 CFS following rain events. The flow has been witnessed to sustain elevated levels for extended periods following storms or rain events due to the installation of watershed ponds or water storage areas that retain the run-off and slowly release to the stream. These periods of elevated flow may have contributed to in-stream instability and erosion.

Nutrients:

Nutrients in terms of water quality include Phosphorus, Nitrogen and Ammonia. These together provide the necessary building blocks for the life of the stream. Although in excess they can inhibit life or cause adverse effects. In 2004 the Pawnee Nation along with the University of Arkansas completed a study of lotic ecosystem trophic status index ratio of Black Bear Creek. The objective of the study was to identify nutrient impacts on stream periphyton growth (Ludwig et al.) The results of the study indicated that the average dissolved inorganic Nitrogen concentrations were significantly correlated with chlorophyll a production on the periphytometer control treatments in the Black Bear Creek basin. Periphytic growth was nutrient-limited, meaning increased chlorophyll a was measured on nutrient-enriched growth media, at four of the ten study sites; two of the sites were limited by Nitrogen and two sites were co-limited by both Nitrogen and Phosphorus. In subsequent years since the study, periphytometer deployments have concluded with similar results. No waters in the watershed are listed as impaired by nutrients, but two lakes (Pawnee and Lone Chimney) are impaired by causes (chl-a and low DO) that can arise from nutrient enrichment.

Pathogens:

In 2008, the Pawnee Nation completed a bacteria source tracking study on lower Black Bear Creek to determine the source of *Escherichia coli* in the waterbody. The Department collected water samples and coordinated with the Oklahoma Department of Agriculture Water Quality Laboratory to utilize the existing DNA Library for comparison of strains cultured. The results of the study indicated at two of the five sites sampled, the source origin was septage (human) while four of the five sites identified cattle as the source origin.

Fecal Coliform bacteria were collected by the Pawnee Nation in Black Bear Creek prior to the transition to *Escherichia coli* beginning in 2007. The average Fecal Coliform count resulted in over 320 CFU/100 ml for the four years of collections. Also the *Escherichia coli* count resulted in over 300 CFU/100 ml. The sampling exceeded the Pawnee Nation Water Quality Standards of 40 CFU/100 ml and according to the Oklahoma Beneficial Use Monitoring Program (BUMP) Report 2004 twenty-four (24) fecal coliform concentrations and seven (7) samples exceeded the prescribed screening level of 400 cfu/ml.

Two stream segments in the watershed (Lower Black Bear Creek and Cow Creek) are listed as impaired by pathogens in the draft 2010 303d list (Table 1 and Figure 7).

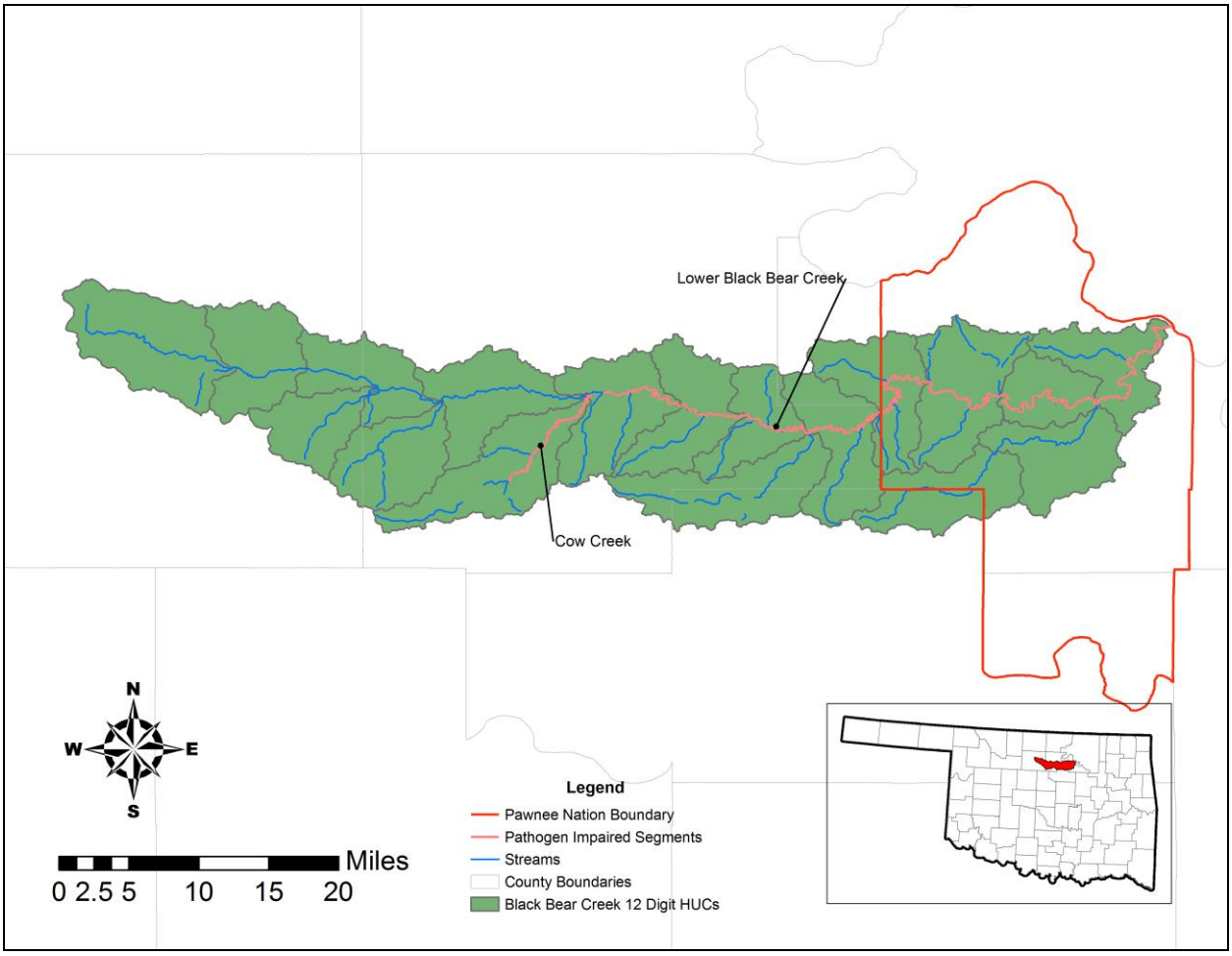

Figure 7. Pathogen impaired segments in the Black Bear Creek Watershed from the draft 2010 303d list.

Specific Conductance, Chloride, Sulfates, and TDS:
Specific Conductance during low flow conditions range from 345µS/cm^2 to 1936 µS/cm^2 during the monitoring period. During 2010 and 2011 monitoring of five sites on the watershed eleven sampling periods were performed; results at the downstream most site the conductivity ranged from 411 µS/cm^2 to 2221 µS/cm^2.

Chloride analysis has been included in the monitoring of Black Bear Creek since 2004. The average concentration of chlorides in lower Black Bear Creek is 138 mg/l. The range of results is from 30.5 mg/l to 457 mg/l. The Pawnee Nation established the water quality standard of 46mg/l in all water bodies within the Pawnee Nation. There are eight stream segments in the watershed that are listed as impaired by chloride, sulfates, and/or TDS (Table 1 and Figure 8). All of these segments are in the upper portion of the watershed.

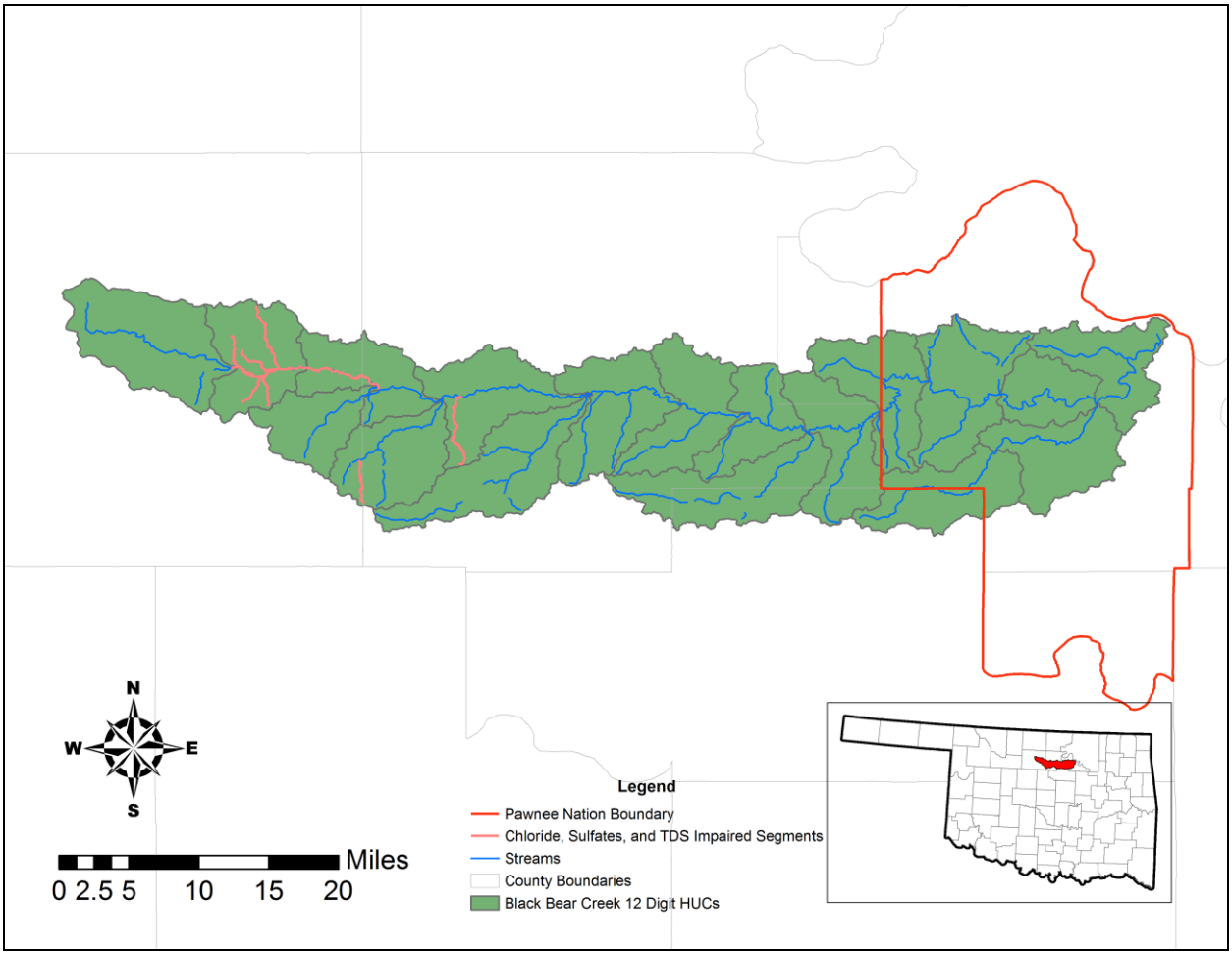

Figure 8. Chloride, sulfates, and TDS impaired segments in the Black Bear Creek Watershed from the draft 2010 303d list.

Turbidity:
Turbidity data collected from the State monitoring stated in the 2004 BUMP Report indicated 31 samples exceeded the numerical criterion of 50 NTUs. While the data from the Pawnee Nation, revealed 41% of the samples exceeded the State criterion; while the Pawnee Nation Standard is 25NTU therefore 65% of the samples would have exceeded.

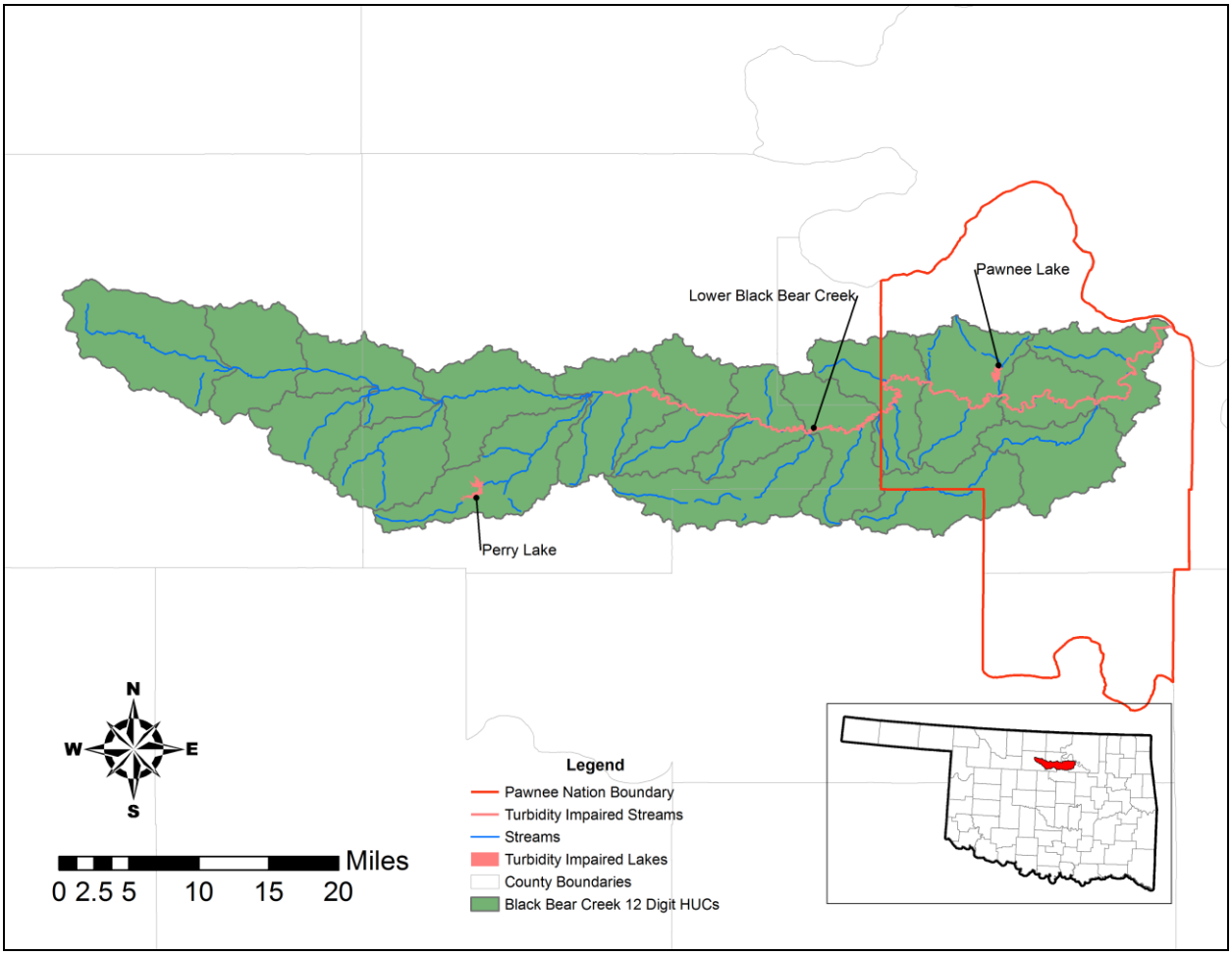

Figure 9. Turbidity impaired segments and lakes in the Black Bear Creek Watershed from the draft 2010 303d list.

Biological Condition:
The Pawnee Nation has conducted bioassessments, both fish and macroinvertebrates, at sites across the BBCW since 2004. Fish collections of Black Bear creek show an absence of intolerant species and dominated by the tolerant red shiner. Richness of species or variety of different species collected throughout the collections averaged moderate when compare to the matrix developed by the Pawnee Nation for the Water Quality Standards. The percent of Darter species collected and the total abundance of fish collected throughout the collections scored high

according the matrix. The percent of tolerant species, carnivores, insectivores and sunfish scored low.

The macroinvertebrates collected from the watershed since 2004 reveal a diverse collection. Although a high percentage of the species collected were Chironomidae, more tolerant to pollution changes in the stream, the target species of Ephemeroptera, Plecoptera and Trichoptera (EPT) were represented by 42% of the macroinvertebrates collected. A large representation of clinger richness and abundance from the macroinvertebrate population represents good in-stream cover (vegetation, woody debris, and substrate) and habitat quality.

CAUSES AND SOURCES

Pollutants enter the water through point sources and nonpoint sources. Point sources release pollutants from a single location while nonpoint sources deliver pollutants from an expansive area. Point sources from regulated industries disperse pollutants in a measureable quantity which depends on stream flow conditions. Nonpoint sources such as rural land use disperse pollutants after rainfall events through surface water runoff and groundwater.

Nonpoint Sources

Cause of Impairment: Turbidity and Pathogens
Source of Impairment: Rural Land Use

During the 19th century, stream banks supported hardwood forest within BBCW. Many riparian forests and wetlands have been degraded or lost due to channelization or land use changes. (Woods et al, 2005) Grazing also contributes to riparian forest loss due to unlimited stream access for the livestock. The 303(d) list identifies grazing practices as a potential source for several impairment causes on Black Bear Creek. "Grazing in riparian or shoreline zones" is identified as a potential source for turbidity, fecal coliform, Escherichia coli, and Enterococcus impairments. "Rangeland grazing" is identified as a potential source for turbidity, fecal coliform, Escherichia coli, and Enterococcus. The 303(d) list identifies "non-irrigated crop production" as potential sources for turbidity impairments on Black Bear Creek. "Wildlife other than waterfowl" is identified as a potential source for fecal coliform, Escherichia coli, and Enterococcus. Scouring and riparian forest loss is also associated with storm water runoff events.

Cause of Impairment: Pathogens
Source of impairment: Rural Land Use, Septic Systems, Municipal Land Use

The populations of municipalities within BBCW have increased within the last century. Infrastructure and impervious surface addition correlate with population rise and increased storm water runoff. For Black Bear Creek, the 303(d) list identifies several municipal items as potential sources for impairment causes. "Highway/road/Bridge Runoff (non-construction related)" is identified as a potential source for turbidity and lead. "Residential districts" are identified as a potential source for fecal coliform, Escherichia coli, and Enterococcus. "On-site Treatment systems (septic systems and similar decentralized systems)" are identified as potential sources of Enterococcus impairments. "Total retention domestic sewage lagoons" and "wastes from pets" are identified as potential sources for Enterococcus impairments.

Table 3. Bacteria Source Tracking study of Lower Black Bear Creek, identifying sources match by Ribotyping samples to potential sources.

Site	*E. coli* (CFU)	Isolates Ribotyped	Samples Matched	Source Matched	Source Origin
Cattlet Bridge	140	4	3	1	Septage
Kansas Street	70	3	2	3	Cattle
Sand Road	100	5	1	3	Cattle, Septage
Lela	80	3	0	3	Cattle
CR270	110	4	2	1	Cattle

Cause of Impairment: Chloride, Sulfates, and Total Dissolved Solids
Source of impairment: Petroleum and Natural Gas Activities

In the fall of 2010, the Pawnee Nation initiated an investigation of the source of the elevated chlorides and conductivity discovered during the routine sampling of the watershed. This investigation identified an area of origin in the upper watershed in Garfield County. This area of origin is located in a densely concentrated oil and gas development field. A specific source has not been identified at this point of the investigation.

The Pawnee Nation partnered with the USGS and Bureau of Land Management to further investigate the source of chlorides in the watershed. The objective of the investigation study is to determine the major ions and total dissolved solids concentrations, ratios of stable oxygen and hydrogen isotopes in the water and the total petroleum hydrocarbons. The analysis of the major ion concentrations will contribute greater understanding of the general quality of surface water in the watershed and ratios between analytes such as bromide and chloride may provide information about sources and mixing in the watershed. Analysis of total petroleum hydrocarbons will provide information as to whether wastewater related to petroleum production or spills of petroleum products are affecting the quality of the watershed.

The State of Oklahoma's 303(d) list identifies "Petroleum/Natural Gas Activities (Legacy)" as a potential source for several impairment causes throughout the BBCW. These activities are identified as a potential source for turbidity within Black Bear Creek, chloride within Garber Creek, chloride and total dissolved solids within Garber Field and Shale, and total dissolved solids within St. John. The Pawnee Nation's water quality data does not limit the ongoing cause of contamination as "Legacy" activity as supported by the USEPA and State of Oklahoma. The data has shown evidence the impairments are (in part) the results of current ongoing oil and gas activities in the source area which are contributing to the impairments.

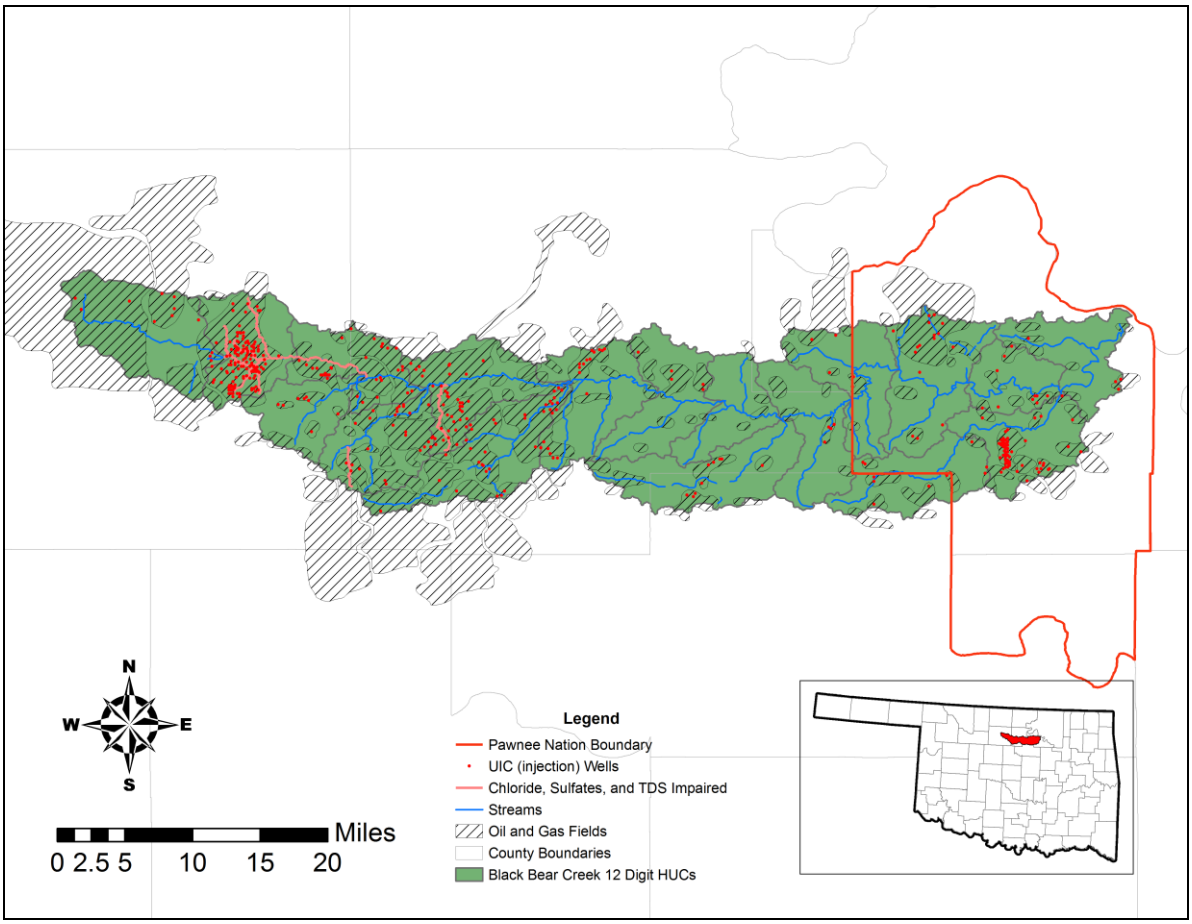

Figure 10. UIC (injection) Wells and Oil and Gas Fields in Black Bear Creek Watershed.

Cause of Impairment: Thallium
Source of impairment: Unknown

The 303(d) list identifies “clean sediments” as a potential source for turbidity and “atmospheric deposition” as a potential source for Thallium within Black Bear Creek. According to the 303(d) list, many potential sources for impairments are considered “source unknown”.

Point Sources

The 303(d) list identifies "municipal point source discharges" or waste water treatment plants (WWTP) as a potential source for lead, fecal coliform, Escherichia coli, and Enterococcus impairments on Black Bear Creek and Escherichia coli, and Enterococcus impairments on Cow Creek.

There are four permitted wastewater discharges in Black Bear Creek watershed: Garber, Perry, Glencoe and Pawnee. These towns provide sewage utilities within city limits for residents and businesses. All permitted facilities are detailed on the map in figure 11.

Table 4. Permitted Waste Water discharges in Black Bear Creek Watershed

			Discharging Limits												
			BOD5 (mg/l)			Total Suspended Solids (mg/l)			CBOD5 (mg/l)	Ammonia (mg/l)	Dissolved Oxygen (mg/l)			Fecal Coliform (colonies/100ml)	
Town	Receiving Stream	Design Flow (MGD)	Spring	Summer	Winter	Spring	Summer	Winter	Summer	Summer	Spring	Summer	Winter	Spring	Summer
Garber	Garber Creek	0.15	20	20	20	30	30	30							
Glencoe	Oak Creek	0.064	25		30	90	15	90	10	2	5	4		200	200
Pawnee	Black Bear Creek	0.3	25	15	25	30	30	30		8	5	5	5	200	200
Perry	Cow Creek	0.66	30	30	30	90	90	90						200	200

There are four general permits in the watershed for operators of Rock, Sand and Gravel Quarries. The general permit does not allow discharge of wastewater to waterbodies included in Oklahoma's 303(d) list of impaired water bodies listed for turbidity for which a TMDL has not been performed or the results of the TMDL indicates that discharge limits more stringent than 45 mg/l for Total Suspended Solids (TSS) are required. (ODEQ BBC TMDL 2010). Table 5 summarizes data from the Oklahoma Department of Mines.

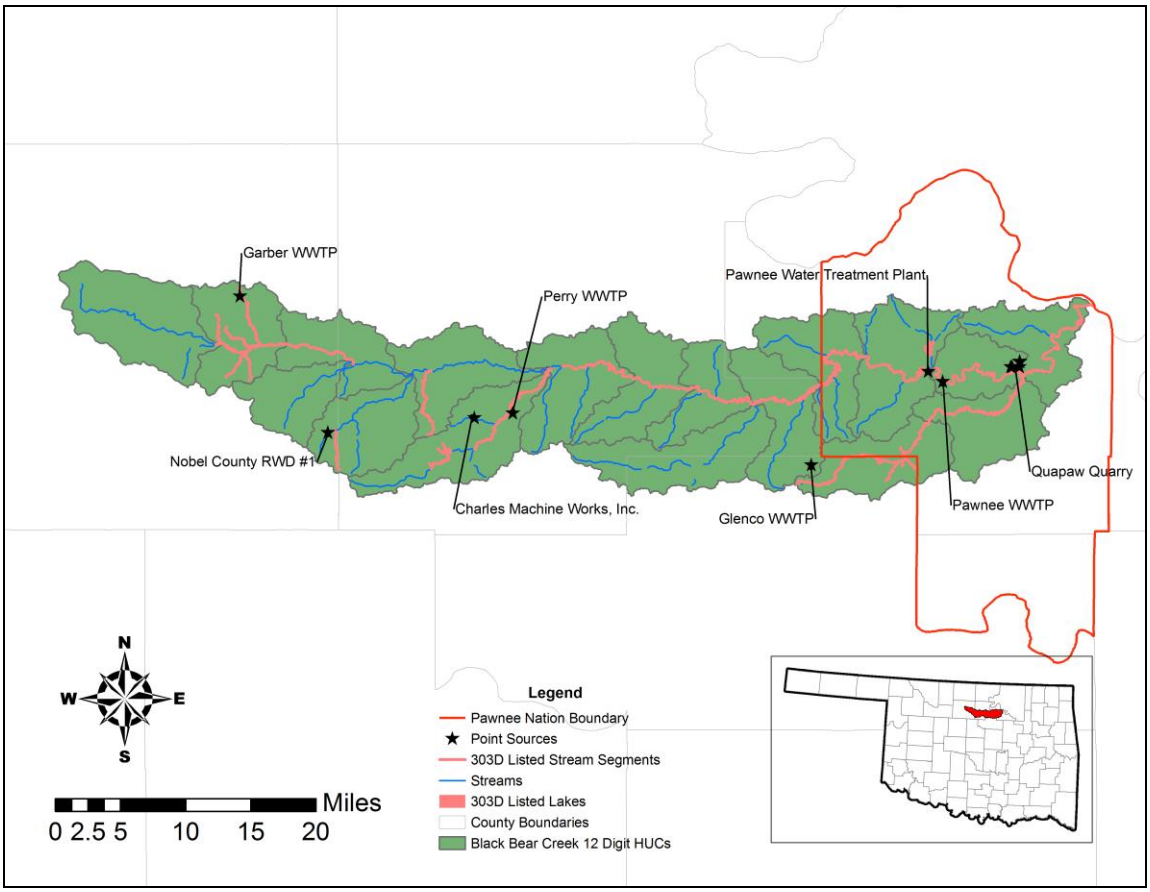

Figure 11. Permitted facilities within the Black Bear Creek watershed.

Table 5. Black Bear Creek permitted Quarries.

Company Name	County	Permit ID	Product	Permitted Acres	Permit Issue Date	Permit Renewal Date	Mining Expiration Date
Stewart Stone (Pawnee Quarry Pit 3)	Pawnee	L.E.-1760-D	Limestone	906.50	12-1-1999	11-30-2008	11-20-2029
Stewart Stone (Privett)	Pawnee	L.E.-1270	Limestone	333.0	12-1-2000	11-30-2008	11-30-2008
Stewart Stone (Pawnee)	Pawnee	L.E.-1734	Limestone	655.00	10-1-1999	9-30-2008	9-30-2029
Quapaw Co. (Bensing)	Pawnee	L.E.-1598-A	Limestone	500.00	3-1-1998	2-28-2009	2-28-2022

LOAD REDUCTIONS

A TMDL for turbidity was completed for ODEQ by Parsons Engineering in August of 2010. The "Turbidity Total Maximum Daily Load for Black Bear Creek, Oklahoma (621200030010_00)" calculated turbidity TMDL's based on total suspended solids calculations for the eastern 68 miles of Black Bear Creek. The TMDL for TSS calls for a percent reduction goal of 60.3 percent. This TMDL did not use modeling to account for the source of the loadings and the 60.3 percent reduction goal was calculated by iteratively lowering measured TSS (Figure 12) across the spectrum of base flow samples and finding the value that resulted in less than 10 percent of the sampling events exceeding 90 percent of the TSS criteria. This results in a gap in knowledge what sources need to be targeted for this reduction and where they are located. In the absence of this information local knowledge and professional judgment must be used to determine the appropriate measures and locations for load reductions. Future TMDL development is scheduled for the other causes of impairment are targeted for completion in 2015 and 2018.

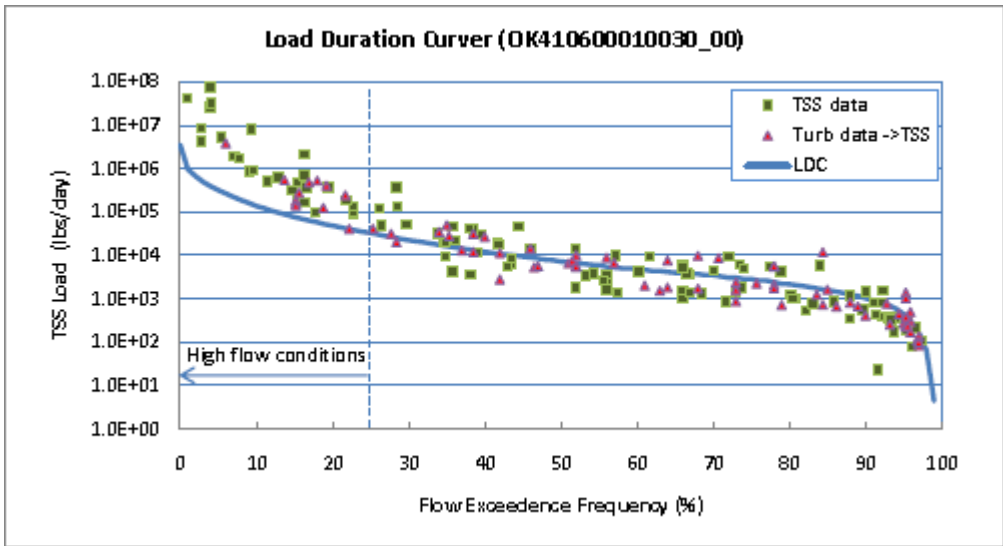

Figure 12. Load duration curve for Total Suspended Solids in Black Bear Creek based on the 40.6 mg/L standard from ODEQ with measured values of TSS plotted for comparison (from Parsons, 2010).

CRITERIA

PAWNEE NATION WATER QUALITY STANDARDS

The beneficial uses of Black Bear Creek as designated by the Pawnee Nation Water Quality Standards include Public and Private Water Supplies, Fish and Wildlife Propagation, Agriculture, Primary Body Contact/Cultural Use, Water Resource Reserves and Groundwater Recharge. Within its jurisdiction the Pawnee Nation has assigned designated beneficial uses and criteria listed in tables 6 and 7.

Table 6. Pawnee Nation Water Quality Standards, Black Bear Creek Beneficial Uses

Black Bear Creek		
Beneficial Uses	Public and Private Water Supplies	General Criteria, Toxic Substances, Biological Criteria, Nutrient Criteria
	Fish and Wildlife Propagation	General Criteria, Biological Criteria, Dissolved Oxygen, Temperature, Toxic Substances, Nutrient Criteria
	Agriculture: Livestock and Irrigation	General Criteria
	Primary Body Contact Recreation/Cultural Use	General Criteria, Biological Criteria
	Water Resource Reserves	General Criteria, Biological Criteria
	Ground Water Recharge	General Criteria, Toxic Substances, Biological Criteria

Table 7. PNWQS Black Bear Creek Criteria

Pawnee Nation Water Quality Standards		
General Criteria	Floating Solids	Narrative
	Color	Narrative
	Odor/Taste	Narrative
	Sediment	Narrative
	Trophic Status	0.8
	Turbidity	25 NTU at low flow
	Total Suspended Solids	15.0 mg/l(normal flow), 30.0 mg/l (any flow greater than normal)
	Bacteria	40 CFU at any time
	Chloride	46.0 mg/l
	pH	6.5 – 9.0
	Fish Tissue	Prevent Bio-Concentrations of Toxic Substances, Section 10(b) PNWQS
Toxic Substances	PNWQS Section 10(b) Table 1	
Biological Criteria	Macroinvertebrates and Fish	Narrative
Dissolved Oxygen		7.0 mg/l at 22°C March 1 – June 15; 6.0 mg/l at 22°C June 16 – February 28
Temperature		At no time shall heat be added to any surface water in excess of the amount that will raise the temperature of the receiving water more than 2.8°C outside the mixing zone
Nutrients	Ammonia	pH<8.0 – 1.71 mg/l NH_3-N pH 8.1-8.5 – 0.87 mg/l ph 8.6-9.0 – 1.34 mg/l
	Nitrates	1.00 mg/l NO_3-N
	Phosphates (Total)	Streams/Rivers 0.1mg/l PO_4-P

OKLAHOMA WATER QUALITY STANDARDS

Black Bear Creek has been designated in Oklahoma Water Quality Standards for the following beneficial uses by the Oklahoma Water Resources Board (OWRB 2006):

- Public and Private Water Supply
- Warm Water Aquatic Community
- Agriculture
- Primary Body Contact
- Aesthetics

Camp Creek including Lone Chimney Lake, Oak Creek, Mule Creek, Cow Creek downstream from Perry Lake and West Warren Creek have the same designations. The tributary of Oak Creek at SE ¼, Sec. 27, T212N, R3E, IM has the same designation except for the Public and Private Water Supply beneficial use. Pawnee Lake and watershed along with Perry Lake and Watershed have the same designations as Black Bear Creek but are also designated as Sensitive Public and Private Water Supplies.

In order to meet the Warm Water Aquatic Community use:

- Turbidity during base flow conditions must contain no more than 10% of samples exceeding 50 NTU for streams, based on at least 10 samples

- Dissolved oxygen (DO) levels for streams must contain no more than 10% of samples below 5 mg/L, or 4mg/L from June 16 to October 16, based on at least 10 samples In order to meet the Primary Body Contact Recreation use for streams, at least 10 samples must be collected during the recreation season from May 1 to September 30.

These samples include:

- Fecal coliform conditions of no more than 25% of all samples exceeding 400 colonies/100 ml and a geometric mean of less than 400 colonies/100 ml.
- *Enterococcus* conditions of no sample exceeding 406 colonies/100 ml and a monthly geometric mean of less than 33 colonies/100 ml.
- Escherichia coli conditions of no sample exceeding 406 colonies/100 ml and a monthly geometric mean of less than 126 colonies/100 ml.

According to the "Turbidity Total Maximum Daily Load for Black Bear Creek, Oklahoma (621200030010_00)" draft, the lower portion of Black Bear Creek violates the turbidity criteria for Warm Water Aquatic Community use.

NPS MANAGEMENT MEASURES

The major goal of this project is to regain the beneficial use criteria standards for Black Bear Creek and the associated waterbodies of concern. Agricultural best management practices (BMPs) improve water quality by reducing sediment, nutrients, and bacteria entering the water. Nonpoint source management measures include restoration efforts utilizing the BMPs. Turkey Creek is a watershed near Black Bear Creek that has similar characteristics. Since an Oklahoma Conservation Commission (OCC) Work Plan for Black Bear Creek has not be created, the OCC Work Plan for Turkey Creek as stated in the Turkey Creek Watershed Management Plan will be implemented with the addition of BMPs from the Pawnee Nation NPS Management Plan.

Riparian Area Establishment and Protection

The number one priority BMP for the Black Bear Creek Watershed is Riparian Areas/Buffer Zones establishment and protection. With a relatively low capital investment required and an extremely high efficiency for nutrient removal, this is the most cost effective method to reduce nonpoint source pollution in the watershed.

- **Reforestation of Riparian Areas**

The restoration of the depleted buffer zones by agricultural activities along the stream should be maintained to reestablish a buffer zone. In accordance with Pawnee Nation Natural Resource Protection Act Chapter 6 by enforcing the Act and providing for replanting of trees would provide for benefits that can include restoring and maintaining the chemical, physical and biological integrity of the water.

- **Fencing for Riparian Management**

Heavily grazed riparian areas function poorly as nutrient traps and cattle trails become channels that transport nutrients directly to the stream. Fencing is recommended to control these problems. Fences may be built above the flood prone area elevation to lower maintenance costs. Short term, rotational grazing may be allowed within the fenced buffer along with a reduced incentive payment.

- **Off Stream Watering**

Pastures where the stream is the primary or sole source of water for livestock must be provided with an alternate source to allow riparian management.
Studies have shown that off stream water sources can substantially reduce the impact of cattle without fencing the stream.

- **Riparian Incentive Program**

Conservation workers in the BBCW area believe that riparian management will be a difficult practice to promote. Landowners look upon the riparian areas as critically needed, highly productive farmland. Landowners are not expected to participate in demonstrating riparian management without generous incentives. The incentives will be used to establish 100 feet on each side of the stream following the three zone buffer system. Riparian buffers of this

size would be the equivalent of 25 acres per mile of stream. In order to take advantage of existing fences, the buffer widths may vary from the desired 100 feet.

- **Buffer Zones**

Accumulation of animal waste around farmsteads and other facilities and runoff from cropland are suspected as significant sources of nutrients. Buffer zones will be installed around these facilities.

- **Pasture Establishment**

Over grazed, poorly grassed or eroding pastures have been identified in the watershed. These lands need attention with reseeding, sprigging, or leveling to reduce sediment runoff. This practice will only be employed where sediment is observed to be entering waterways and will be coupled with a grazing management plan.

- **Floodplain Management**

The management of floodplains and floodways should be at the watershed level. Runoff anywhere within the watershed can increase the incidence and magnitude of floods downstream as well as water quality within the system. Construction and development within the watershed can be managed to achieve water quality protection, streambank protection and flood mitigation.

Bacteria Loading Reduction

Another priority BMP for the Black Bear Creek Watershed is bacteria loading. Sources of bacteria within the watershed as identified by studies include livestock and human sources. The implementation of education and assistance to owners of septic systems and confined animal feeding operations would be the most cost effective.

- **Septic Systems (Rural)**

  An inventory and inspection of rural waste water treatment systems would assist in the reduction of bacteria into the watershed by upgrading and maintaining failing systems. Once failing systems are identified prioritization of these systems would be completed and funding assistance could be targeted. With the assistance of the Indian Health Service and Oklahoma Department of Environmental Quality these systems could be upgraded and proper maintenance guidance provided.

- **Wastewater Treatment Plants**

  Assistance and education would be a target for the smaller rural communities as well as permit renewal review. This would be a larger requirement for financial assistance due to the cost of upgrade and maintenance.

- **Confined Animal Feeding Operations (CAFOs)**
  As a cost effective management options for these operations would include waste management BMPs, proper fencing and location of operations by zoning and other off stream water options. Inspections and assistance are provided through the permitting process.

- **Stormwater Management**
  Stormwater management is significant in large urban communities whereas, the smaller communities within Black Bear Creek Watershed these measures are not taken. Education of the management of stormwater is a priority to the residents of the communities. The actions taken through education will lead to a transition of the communities. Modeling of both urban and rural stormwater management systems throughout the watershed is needed to understand the significance of the

Nutrients Load Reduction

Nutrients provide the necessary building blocks for the life of the stream. Although in excess they can inhibit life or cause adverse effects.

- **Fertilizer Application Management – Agriculture**
  Encourage regular soil tests to determine nutrient needs of the field. This will ensure accurate soil information to prevent over or unneeded application of fertilizers.

- **Conservation Tillage**
  The use of conservation tillage to crop lands would assist in the minimization of the loss of phosphorus that is attached to the soil. This would also benefit the potential for erosion of the soil.

- **Wetland Management**
  An accurate inventory and assessment of wetlands within the watershed would benefit the management of the water quality by providing areas targeted for protection and ensuring any adverse ecological effects. The development of a Wetland Management Plan is instrumental in the protection of the wetlands within the watershed and overall protection of water quality.

Chloride Load Reduction

- **Oil and Gas Operations**
  The oil and gas operations include exploration and operating a producing well. Education to these drillers and operators on best management practices are instrumental to the prevention of watershed contamination. Implementing BMPs, enforcing laws and regulations and managing stormwater from the beginning will impede potential water quality issues.

- **Transportation**
  During winter months and winter storm events road salts are applied to most highways and major transportation arteries throughout the watershed. Education to these agencies regarding the impact of salts to the water column and the long term effects to the biota of the system will assist in awareness and potential shift to alternative practices.

TECHNICAL AND FINANCIAL ASSISTANCE NEEDED

The amount of technical and financial assistance needed for this project is closely tied to one another. All programs to implement NPS BMPs require technical assistance in the form of a plan writer. Funding a 319 programs or Conservation Reserve Enhancement Program must come from funds other than the Tribe or other typical federal sources.

Estimates of funding planned or already being implemented for technical support in the watershed are shown in the following table. These are multiyear projects and some are single year efforts. At a minimum approximately $50,000 is required for technical support each year to provide support to the conservation districts and personnel to meet with landowners and draft conservation plans.

Table 8 Annual Funding Sources and Financial Assistance

Possible Funding Sources	Task	Federal	Cost Share Funds	Total
Tribal Water Quality Monitoring/Nonpoint Source Management	Coordinator			$20,000
	Support			$20,000
CWA §319 Program	Support	100,000	20%	$120,000
NRCS Districts Conservationists				?
Oklahoma Nonpoint Source Program				?
Bureau of Indian Affairs				?
Indian Health Services				?
				$160,000

The financial assistance for implementation is difficult since no modeling has been done to identify the number and area of BMPs needed for TMDL target reductions. Computer modeling to assess the effect of implementation efforts is estimated to require $100,000 - $250,000 for the entire Black Bear Creek watershed every five years.

Table 9 Financial Requirements with Associated Tasks

Task	Tribal	Federal	State	Total	Agency
Black Bear Creek 319 Project, Computer Modeling	$20,000	80,000		$100,000	Pawnee Nation, OCC, BIA
Implement Riparian Establishment Project	$20,000	80,000	20,000	120,000	Pawnee Nation, OCC, Conservation Districts and BIA
Implement Bacteria Load Reduction Project	$20,000			100,000	Pawnee Nation, OCC, BIA, IHS
Implement Nutrient Load Reduction Project				100,000	Pawnee Nation, OCC, Conservation Districts, BIA
Implement Chloride Load Reduction Project				100,000	Pawnee Nation, OCC, Ok Corporation Commission, BIA, BLM

Table 10 Monitoring Program Funding

Monitoring Program	Parameters Assessed	Tribe	State	Federal	Total
Pawnee Nation Stream Monitoring	Chemical, Physical and Biological Monitoring			$200,000	$200,000
OCC Rotating Basin	Stream water quality, biological community, habitat, Hydraulic budget, riparian and landuse/landcover			$10,000 to $30,000 every 5 years	$10,000 to $30,000 every 5 years

IMPLEMENTATION SCHEDULE AND INTERIM MILESTONES

The overall project timeline will occur over a five year period. As the first step in implementing the TMDL recommendations, the Project Coordinator will contact the types of landowners identified in the TMDL to encourage them to participate in the available programs. Table presents implementation projects for the Black Bear Creek Watershed. The implementation milestones is shown in Table, while the implementation schedule is in Table.

Table 11 Implementation Projects for the Black Bear Creek Watershed Project

Parameter	Target Action	Description	Implementation Projects
Turbidity	Riparian Establishment	Reforestation of Riparian	Replant trees
		Fencing for Riparian (livestock exclusion)	Fencing
		Streambank Stabilization	Develop BMPs
		Roadway Maintenance	Educate
			Develop BMPs
		Floodplain Management	Low impact development
			Stormwater BMPs
			Permit Management
Bacteria	Loading Reduction	Septic Systems (Rural)	Inventory/Inspect
			Upgrade failing systems
			Educate O&M
		Wastewater Treatment Plants – Municipalities	Assist and Educate O&M
			Upgrade
		Cattle – CAFOs	Waste Management BMPs
			Fencing
			Off stream watering BMPs
		Stormwater Management	Educate on Stormwater Management
			Model urban and rural stormwater management systems
			Develop BMPs for stormwater management
Nutrients	Load Reduction	Riparian Reforestation	Replant trees
		Wetland Management	Inventory
			Ensure permit compliance
		Fertilizer Application Management	Assistance and Applicator Education
			Soil testing and analysis
		Wastewater Treatment Plants – Municipalities	Assist and Education O&M
		Septic Systems (Rural)	Inventory/Inspect
			Upgrade failing systems
			Educate O&M
		Stormwater Management	Educate on Stormwater Management
			Model urban and rural stormwater management systems
			Develop BMPs for stormwater management

Parameter	Target Action	Description	Implementation Projects
Chlorides	Load Reduction	Oil and Gas Operations	Education
			Spill remediation
			Code enforcement
			Injection well management
			Remediate or Plug abandon wells
		Transportation Agencies	Education of Transportation Agencies – roadway salts
			Develop alternatives to hazardous road maintenance

Table 12 Interim Milestones for the Black Bear Creek Watershed Project

Project	Description	Responsible Party	Year 1	Year 2	Year 3	Year 4	Year 5
Black Bear Creek Watershed Management 319 Project	Staff – project and education coordinators and plan writer	PNDECS, OCC, Conservation Districts	■	■	■	■	■
	Establish agreement with stakeholders	PNDECS, OCC, Conservation Districts	■	■			
	Black Bear Creek Computer Modeling	PNDECS, OCC	■	■			
	Implement Riparian Establishment Project	PNDECS, OCC, Conservation Districts	■	■	■	■	■
	Implement Bacteria Load Reduction Project	PNDECS, OCC, Conservation Districts		■	■		
	Implement Nutrient Load Reduction Project	PNDECS, OCC, Conservation Districts			■	■	
	Implement Chloride Load Reduction Project	PNDECS, OCC, Conservation Districts				■	■

Table 13 Implementation Schedule for the Black Bear Creek Watershed Project

Goal	Action	Parameter to Address	Load Reduction Goal	Year to Begin	Year to Evaluate and Adjust	Year to Complete
Characterize NPS contributions	Targeting	Turbidity, Bacteria, Nutrients, Chlorides, DO		2013	2018	Repeat at five year intervals
Develop education and outreach programs	PNDECS 319 Program, OCC 319 Program	Turbidity, Bacteria, Nutrients, Chlorides, DO		2013	Semiannually throughout project period	2018
Black Bear Creek 319 Project	PNDECS	All		2013	Annually	2014
Implement BMPs and establish easements	PNDECS 319 Program, OCC 319 Program, EQUIP	Bacteria, Turbidity, Nutrients			Semiannually	
Implement Riparian Establishment Project	PNDECS 319 Program	Turbidity, Bacteria, Nutrients	>60%	2013	Annually	2018
Implement Bacteria Load Reduction Project	PNDECS 319 Program, OCC 319 Program	Bacteria	>96%	2014	Annually	2016
Implement Nutrient Load Reduction Project	PNDECS 319 Program, OCC 319 Program, Conservation Districts	Nutrients, Bacteria	30%	2015	Annually	2017
Implement Chloride Load Reduction Project	PNDECS 319 Program, OCC 319 Program, OK Corp. Commission	Chlorides	90%	2017	Annually	2018
Long term water quality monitoring programs	PNDECS 319 program and 106 program,	Turbidity, Bacteria, Nutrients, Chlorides, DO	N/A	2013	Annually	Ongoing
	OCC 319 Program and Rotating Basin			2013	Every 4 years	Ongoing
	OWRB BUMP			2013	Biannually	Ongoing
	Blue Thumb			2013	Annually	Ongoing

PUBLIC OUTREACH

This Plan is intended to have a long term effect on the behavioral changes of the residents in the watershed to ensure the protection of water quality. To achieve the goal, the education program will ensure widespread adoption of these practices over the entire watershed.

The education program will be guided by the Pawnee Nation NPS coordinator and County Conservation Districts Managers. Personnel may be appointed to the education committee or the coordinators will sit on the committee. Landowners and other stakeholders will be invited to participate in the education program.

The education committee will draft a work plan to meet the education goals of this plan. It will include educational goals, measures of success, detailed budget and outputs to document task activities. The education work plan will include:

1. Develop a series of tours of demonstration sites in the watershed.
2. Develop a newsletter for Black Bear Creek Watershed landowners.
3. Development of brochures that explain the 319 Program.
4. School education.
5. Exhibits – develop a display to educate the public about the project.
6. Plan and conduct educational meetings to include: tours, earth days, fairs, etc.
7. Develop the Blue Thumb program in the watershed.
8. Conduct cooperator/producer seminars.
9. Develop a recognition program for project cooperators.
10. Develop a survey to measure changes in behavior that might be a result of the project.

MONITORING PLAN

Every Watershed Based Plan requires a monitoring component to gauge overall success of restoration and remediation efforts. The goal of the monitoring plan for this project is to develop a long-range program with clearly defined foals that will guide the restoration of the beneficial use support in the watershed and preserve its natural resources for future generations. Monitoring efforts will be based on Pawnee Nation Water Quality Standards and Oklahoma Water Quality Standards where applicable. As well as Use Support Assessment Protocols which define the process by which beneficial use support must be determined. All procedures carried out directly by the Pawnee Nation and Oklahoma Conservation Commission will proceed in accordance with the Standard Operation Procedures for Water Quality Monitoring and Measurement Activities and Quality Assurance Project Plans.

Methodologies developed for use in monitoring for this project will be selected to provide: 1) quantifiable measure of changes in parameters of concern, 2) success measures that can be easily understood by cooperators and stakeholders with a variety of technical backgrounds, and 3) consistent, compatible information throughout the watershed. As the Plan evolves it is anticipated that this list will be amended. A monitoring schedule and Quality Assurance Project Plan will be developed.

Monitoring will focus on the primary causes of impairment, as listed in the 303(d) list, but will also consider related causes that may exacerbate the impacts of the primary causes or may ultimately reach impairment levels without improved management. The primary types of monitoring to be conducted in the Black Bear Creek watershed may include:

- Surface water quality: nutrients, sediments, suspended solids, fecal bacteria, dissolved oxygen, temperature, pH, conductivity chlorides, alkalinity, turbidity chlorophyll-a.
- Hydraulic budget: instream flows, infiltration rates, aquifer recovery, groundwater levels
- Groundwater quality: nutrients, metals, pesticides, pH
- Land use/Land cover: acreage in different land uses, quality and type of land cover, timing and other variables of associated management practices
- Riparian condition: extent and quality of riparian zones in the watershed, including quality and type of vegetation, degree of impact or stability, condition of stream banks, and primary source of threat or impact
- Aquatic Biological Communities: assessment of condition of fish and benthic macroinvertebrate communities related to reference streams and biocriteria
- BMP and other implementation efforts coverage type, extent, and when possible, specific location of practices it include an estimate of het potential load reduction effected by implementation
- Behavioral change-participation in Watershed Based Plan-related activities and behavioral changes of affected communities

- Sediment quality-nutrients, pesticides, other organics of concern

The ultimate measure of success of the project will be restoration of beneficial use support in Black Bear Creek and protection of its natural resources. However, due to the size of the watershed and the extent of the problem in Black Bear Creek, it is unlikely that significant improvements in water quality will be measurable at the end of the project period. Therefore, water quality monitoring to evaluate success of the project should occur on a routine basis as part of other programs (listed later in the report) rather than devoting substantial funds toward monitoring during the implementation effort. GIS targeting at the end of the project will also be done to measure changes in landuse and cover quality.

As described in this plan, substantial monitoring has been completed in the Black Bear Creek watershed and has identified numerous water quality problems. Critical areas that are suspected to contribute most significantly to NPS loading in the watershed will be identified through ongoing monitoring. This information will provide a comparison to the baseline data for evaluation changes in water quality and potential sources over the project period.

Baseline Data

The baseline data to evaluate progress in the Black Bear Creek watershed has been established by the Pawnee Nation Department of Environmental Conservation and Safety (DECS) and the TMDL as the water quality data collected by the Oklahoma Conservation Commission (OCC) from 1997 to 2007. Monthly water quality data were collected from 2004 to present at five sites by the Pawnee Nation DECS and from 1997 to 2007 at five sites by the OCC. Table --- provides information on the location of the monitoring sites.

Table 14 Black Bear Creek Watershed Monitoring Sites.

Site Name	Latitude	Longitude	County	Agency
Cattlet Bridge	36.3340556	-96.7794722	Pawnee	PNDECS
Kansas Street	36.3406389	-96.8136667	Pawnee	PNDECS
Sand Road	36.3600833	-96.8892500	Pawnee	PNDECS
Lela	36.3258611	-96.9249722	Pawnee	PNDECS
CR270	36.3068056	-96.9962778	Noble	PNDECS
BBC Upper	36.346222	-97.210833	Noble	OCC
BBC Upper	36.306778	-96.9960278	Noble	OCC
BBC SH18	36.3434116	-96.79985	Pawnee	OCC
BBC Lower	36.339861	-96.69211	Pawnee	OCC
BBC Lower	36.33986	-96.69211	Pawnee	OCC

Data Collection Responsibilities for Future Monitoring

Water quality monitoring will occur on a routine basis as part of other programs ongoing in the watershed. Responsibility for the collection of additional data of the types described above will reside with project managers of individual projects as spelled out in their individual work plans. These project managers will be responsible for ensuring that the data is submitted to be uploaded to the National STORET database.

The following groups will be involved in monitoring activities:

- Pawnee Nation of Oklahoma Department of Environmental Conservation and Safety CWA 106 Water Pollution Control Project
- Oklahoma Water Resources Board: Beneficial Use Monitoring Program and Oklahoma Water Watch Monitoring Program
- Oklahoma Conservation Commission: Rotating Basin Monitoring Program, Priority Watershed Project monitoring, Blue Thumb Program monitoring
- U.S. Geological Survey: Surface and Groundwater quality and quantity monitoring and special studies
- Oklahoma Department of Agriculture, Food, and Forestry: Soil sampling associated with CAFO regulations
- Agricultural Research Service: CEAP monitoring

Benefits of the Monitoring Plan

Implementation of this monitoring plan will enable Black Bear Creek watershed partners to meet the goals of the WBP, which is ultimately to restore beneficial use support to waters of the Black Bear Creek watershed. Implementation of the monitoring plan will help further define areas of the watershed where restoration activities should be focused to realize the optimum benefit for the investment as well as evaluating the impacts (realized and potential) of implementation efforts. Collection of the data described under this monitoring plan will help define the relative contributions from various sources in the watershed and the processes contributing to water quality degradation in the watershed. And finally, continued collection of this data and evolution of the monitoring plan for the watershed will allow the program to adapt to meet the changing needs of watershed protection in the Black Bear Creek Watershed.

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