Delaware River Watershed Restoration And Protection Strategy

May 2007

DELAWARE RIVER WATERSHED RESTORATION AND PROTECTION STRATEGY

By Marlene K. Bosworth
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MISSION STATEMENT

The mission of the Delaware River Watershed Restoration and Protection Strategy (WRAPS) is to provide the framework for the implementation of water quality improvement practices and behaviors through technical, informational, educational and financial assistance to stakeholders in the watershed. Our goal is to restore the watershed to a condition with clean water, healthy habitats and open spaces for human and wildlife communities. We aim to make the watershed a place where people work together to sustain mutual economic and environmental well-being.

- WRAPS is a "community-based" watershed management project, with the "community" being the Delaware River Watershed. Its goal is to protect and restore watershed functions while considering the social and economic factors of the human and non-human residents of the community and the benefits of those watershed functions to each.

- Everyone lives in a watershed and is part of a watershed community. The actions of individuals can have a positive or a negative impact on the health of natural resources (the soil, water, air, plants and animals) in their watershed. Small watersheds join together to form larger watersheds, much like many branches on a tree together form the whole tree. What happens in individual, smaller watersheds affects larger watersheds downstream.

A **WATERSHED** is the area that water flows across or under on its way to a particular stream, river, lake or ocean. The **DELAWARE RIVER WATERSHED** is the area that water flows across or under on its way to the Delaware River in northeast Kansas, an area of over 1,110 square miles. The Delaware River terminates at its confluence with the Kansas River south of Perry Lake Reservoir near the city of Perry, Kansas.

ACKNOWLEDGMENTS

The Delaware River Watershed Restoration and Protection Strategy was made possible through sponsorship of the Glacial Hills Resource Conservation and Development Region, Inc. in Valley Falls, Kansas, Gary Satter, Director. The Kansas Department of Health & Environment has provided financial assistance to this project through an EPA Section 319 Nonpoint Source Pollution Control grant and through Kansas Water Plan funds.

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Thanks to Debra Baker, Kansas Water Office, and Melissa Arthur, Kansas Association for Conservation and Environmental Education, for editing assistance. Thanks also to Mary Fund of the Kansas Rural Center for taking notes and providing assistance with stakeholder meeting minutes, and to Jim Marietta, District Conservationist for the Natural Resources Conservation Service, Jefferson County for ideas and vision in planning BMP's for the watershed.

Thanks to the many landowners, agency and local government representatives and other interested individuals who took time out of busy schedules to attend meetings, provide information and give input into the development of this Plan.

TABLE OF CONTENTS

ACRONYMS AND MEANINGS

BOD = Biological Oxygen Demand
CSP = Conservation Security Program
CRP = Conservation Reserve Program
EPA = Environmental Protection Agency
EQIP = Environmental Quality Incentives Program
FCB = Fecal Coliform Bacteria
FSA = Farm Services Agency
HUC = Hydrologic Unit Code
KAWS = Kansas Alliance for Wetlands and Streams
KBS = Kansas Biological Survey
KDA = Kansas Department of Agriculture
KDHE = Kansas Department of Health and Environment
KDOT = Kansas Department of Transportation
KDWP = Kansas Department of Wildlife and Parks
KFB = Kansas Farm Bureau
KGS = Kansas Geological Survey
KRC = Kansas Rural Center
KRWA = Kansas Rural Water Association
LEPP = Local Environmental Protection Program
MCL = Maximum Contaminant Level (for drinking water)
MSL = Mean Sea Level
NASS = National Agricultural Statistics Service
NEKES = Northeast Kansas Environmental Services
NPDES = National Pollutant Discharge Elimination System
NRCS = Natural Resources Conservation Service
PF = Pheasants Forever
PWS = Public Water Supply
QF = Quail Forever
SCC = State Conservation Commission
SERVE = Service, Education, Referral, Verification and Enforcement (Program proposed by NEKES)
SWA = Source Water Assessment
SWPP = Source Water Protection Plan
TA = Technical Assistance
TBD = To Be Determined
TDS = Total Dissolved Solids
TMDL = Total Maximum Daily Load
TSS = Total Suspended Solids
USFWS = U.S. Fish and Wildlife Service
WHPP = Well-Head Protection Plan

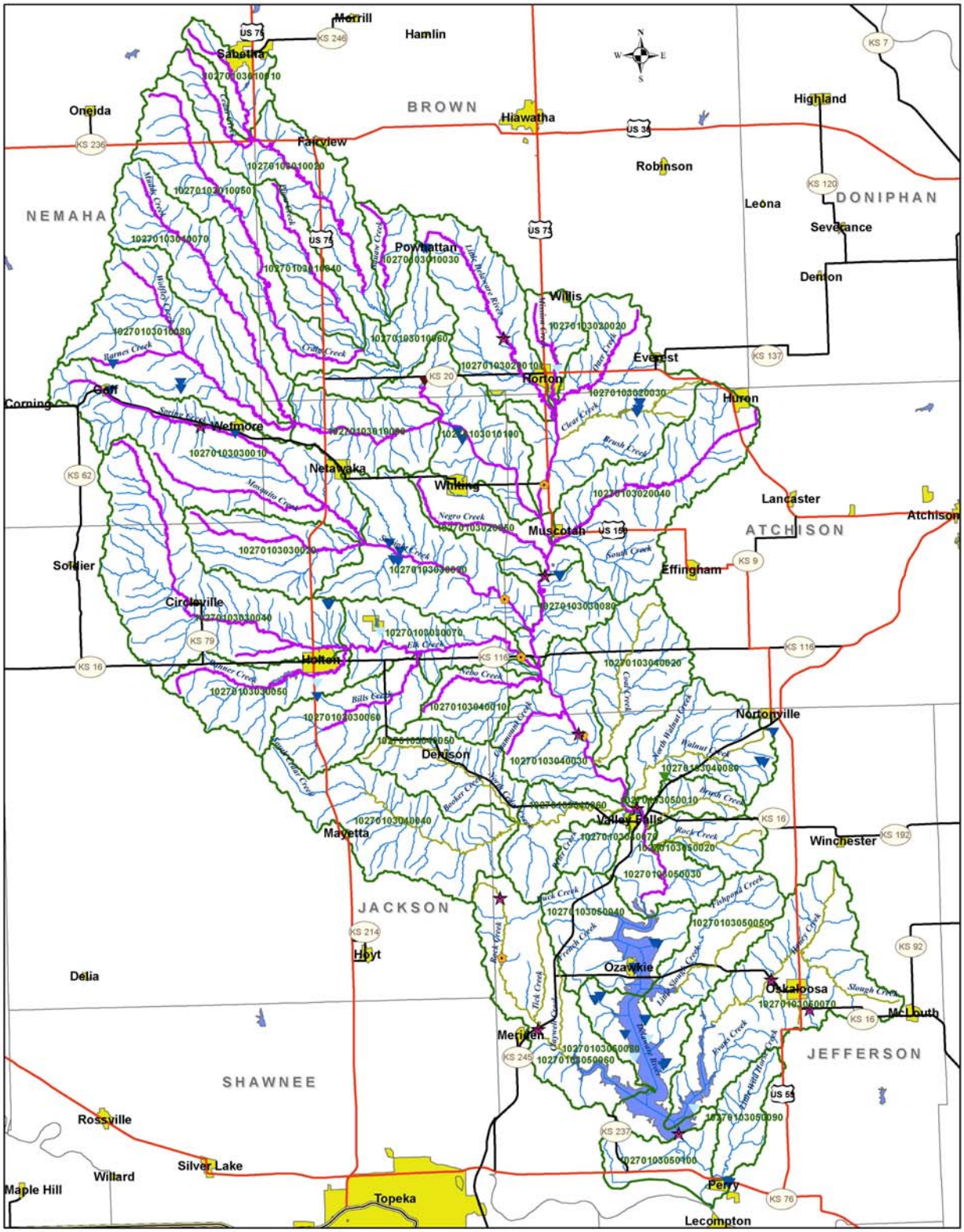
ABSTRACT:

Watershed residents, landowners, representatives of local governments, natural resource agencies and organizations, public waters supplies and others participated in development of this Watershed Restoration and Protection Strategy (WRAPS) for the Delaware River watershed. The Delaware River WRAPS was initiated by the Glacial Hills Resource Conservation & Development Region in Valley Falls, Kansas, sponsor of the project, and funded through EPA Section 319 Nonpoint Source Pollution Control grant and Kansas Water Plan funds.

The Delaware River Watershed, located in northeast Kansas, faces many challenges related to water. The first step in the WRAPS process was the identification of the most important of those challenges by stakeholders from the watershed itself. Grassroots involvement of local people and groups who live or work in the watershed to identify water problems, come up with solutions and develop a plan to address those problems, is a relatively new approach to watershed planning in Kansas.

Seven major water issues were identified and prioritized by watershed stakeholders beginning in late 2005 through early 2007. These seven major water issues include, in order of priority: sedimentation, nutrient management, fecal coliform bacteria contamination, pesticide contamination, household hazardous wastes, water wells, and point sources of pollution. Major objectives related to these issues include reduction of sediment loads to streams and lakes by stabilization of stream banks and reduction of erosion from cropland and grassland; reduction of phosphorus levels in major lakes in the watershed; reduction of bacterial contamination of water from human and livestock wastes; reduction of pesticide contamination from both urban and agricultural sources; establishment of household hazardous waste programs for the entire Delaware River watershed area; protection of public and private groundwater supplies; and assistance for small wastewater systems in the watershed in completing upgrades to meet NPDES requirements.

An array of best management practices, educational and informational activities and other practices designed to address these issues and objectives were developed and prioritized. Relevant water quality information for the watershed was researched and compiled in order to aid in the development of priority issues and make decisions on how best to address them. The Delaware River Watershed Restoration and Protection Strategy plan summarizes the water quality information that was compiled for the watershed, and documents the process and decisions made by the stakeholders involved in its development.



Delaware River Watershed

Legend

- USGS River Gauging Stations
- Kickapoo Nation Water Supply Site
- KDHE Active Water Quality Monitoring Sites
- Intake
- Reservoir
- Spring
- Well
- County Boundaries
- Interstate Highways
- Federal Highways
- State Highways
- Watershed and HUC 14 Boundaries
- Rivers and Streams
- High Priority TMDL Streams
- Lakes
- Cities

0 1.5 3 6 9 12 Miles

Map Produced by
Kansas Department of
Health and Environment
August 2006

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By Marlene K. Bosworth

INTRODUCTION

Watershed restoration and protection efforts are needed to address a variety of water resource concerns in Kansas. Concerns include issues such as water quality, protecting public water supplies, flooding, wetland and riparian habitat protection, and others. The State of Kansas committed to implementing a collaborative strategy to address watershed restoration and protection issues when the Governor's Natural Resources Sub-cabinet adopted the Kansas Watershed Restoration and Protection Strategy (KS-WRAPS) in May, 2004.

The KS-WRAPS effort establishes a new way of approaching watershed issues for Kansas. The effort places emphasis on engaging watershed stakeholders in implementing a stakeholder developed action plan that achieves watershed goals established by the stakeholders themselves. This allows for an individualized approach to watershed issues across the state, with input, guidance, and action to achieve watershed improvements coming from the people who live and work in the watershed. Funding for the development of Watershed Restoration and Protection Strategy (WRAPS) plans for individual watersheds was made available to sponsoring groups, using Kansas Water Plan funds and EPA Section 319 Nonpoint Source Pollution Control Grant funds through the Kansas Department of Health & Environment (KDHE).

The Delaware River WRAPS project started when the Glacial Hills Resource Conservation & Development (RC & D) Region, Inc. in Valley Falls, Kansas, took on sponsorship of a Delaware WRAPS project. The RC & D applied for and received a grant from KDHE in late 2005. Individuals with an interest in water resources in the Delaware watershed met and began the process of identifying water-related issues in the basin in December, 2005. A Coordinator for the Delaware River WRAPS project was hired in February of 2006 to guide the development of the WRAPS planning effort in the basin, and to work with stakeholders. Twelve public meetings were held in various locations throughout the watershed in 2006 to gather input from local stakeholders. A variety of other public informational activities were also undertaken to make the public aware of the WRAPS planning effort, and to gather input.

This effort resulted in a diverse group of stakeholders becoming involved in the Delaware River WRAPS planning process. Farmers, landowners, representatives of natural resource agencies

and organizations, tribal, city and county government representatives, public water suppliers and others participated. The group identified watershed priorities and issues, gathered information, planned how resource concerns would be addressed, and prioritized issues and actions that should be taken. In addition to the educational benefits achieved thus far, a major outcome from this whole process is the development of the Delaware River Watershed Restoration and Protection Strategy document. This document is the result of more than 16 months of public debate, input and sharing of ideas. It documents watershed information and the decisions of stakeholders involved in its development.

The Delaware River WRAPS Plan focuses on seven major water issues that are of greatest concern in the basin (sedimentation, nutrient management, pesticides, fecal coliform bacteria, household hazardous waste disposal, water wells and point sources). Specific objectives and best management practices necessary to meet those objectives were developed to address these seven major issues.

It should be noted that the issues identified and discussed in this document are dealt with as individual issues, yet they are inexorably interrelated. Water issues are seldom separate and discrete from one another. Sedimentation issues are a good example of the inter-relatedness of these issues. Sedimentation in Kansas lakes is a result of erosion that comes about from both natural and man-made sources. It is an issue critical to water quality because sediment itself is a pollutant, and it also has a negative impact on water quantity. Sediment acts in tangent with other pollutants like pesticides, phosphorus, and bacterial contaminants as these materials can be attached to sediment particles, hitching a ride to streams and lakes in the watershed. Runoff that transports sediment also carries other materials in solution that do not adsorb to sediment, but that cause significant water quality problems themselves. So when sedimentation is discussed as a serious water quality and quantity concern, it must also be viewed in context with pesticide contamination, algae blooms and eutrophication, public water supply issues, land management practices and other factors.

DESCRIPTION OF THE AREA
DELAWARE RIVER WATERSHED, HUC 10270103

LAND AREA

The Delaware River Watershed is an area of land approximately 1,157 square miles (740,772 acres) in size that drains a portion of northeast Kansas. The Watershed includes parts of five counties: Atchison, Brown, Jackson, Jefferson and Nemaha. Perry Lake, a federal reservoir managed by the U.S. Army Corps of Engineers, is located on the southern end of the watershed. A map of the watershed appears on **page 10**.

SOIL CHARACTERISTICS

Located in the Dissected Till Plains of northeast Kansas, the area is characterized by dissected deposits of glacial till composed of silt, clay, sand, gravel and boulders overlying bedrock of

primarily shale and limestone. Mean annual precipitation for the area ranges from 35 inches at the northern end of the watershed, to 39 inches in the southeast near the city of Oskaloosa [NRCS, Rapid Watershed Assessment, December, 2006].

Slope, soil permeability, and land use are primary determinants of runoff. Land slopes in the Delaware River watershed range from nearly level to gently sloping in the flood plains, and gently sloping to steep in the uplands. Most slopes are less than 10%, but can be as steep as 25-40% in some areas. Generally speaking, soil permeability is lower in the uplands, and higher in the flood plains due to variations in soil makeup. Low soil permeability rates result in slow infiltration of rainfall into soils, causing high runoff potential during heavy rainfall events. Average soil permeability in the watershed is 0.4 inches/hour.

LAND USE

The predominant land use in the watershed is agricultural. According to the 2002 Census of Agriculture, 86% of the land area in the five counties in which the Delaware River watershed is located is contained in farms. Natural Resources Conservation Service data [NRCS, December 2006] for the watershed estimates that 35% of the watershed is in cropland and 51% is used for pasture or rangeland. Approximately 10% of the area is in trees, much of which is concentrated in southern areas of the watershed. The remaining 5% of the total land area is in urban and residential use, open water area, and other non-agricultural use.

Agricultural statistics for the region are reported on a county-wide basis. Because only portions of five counties are in the Delaware River drainage, agricultural land use and livestock production data is inclusive of an area larger than the area in the Delaware River Watershed itself. However, this data is still useful to gain an understanding of land use and watershed averages should not vary significantly from county-wide averages.

***Agricultural Chemical Use*:** Agricultural chemical use is widespread in the Delaware River watershed. According to the 2002 Agricultural Census, 39% of the total land area in these counties received commercial fertilizer, lime and soil conditioner applications in 2002. This included 54% of the cropland and 43% of pasture and rangeland acres. In the first 6 months of 2006, approximately 54,000 tons of fertilizer was used in the 5 counties [Kansas Department of Agriculture website]. Approximately 16,800 tons were total nitrogen, and 8,400 tons were total phosphorus. A relatively small percentage of the cropland in the five counties receives manure applications (about 3% or 30,698 acres). See **Table 1** for a summary of this data.

According to the National Agricultural Statistics Service, insecticides were used on 5%, and herbicides were used on 31% of the total land area of the five counties. Herbicide use on crops is very common. Historically, atrazine has been the most widely used herbicide in Kansas and was used on over ¾ of corn and sorghum planted. However, the development of new herbicides and "roundup (glyphosate) ready" corn and soybeans has changed herbicide usage. In 2005, atrazine use in Kansas declined to 59% of corn acres. Glyphosate was used on 59% of corn and over 90%

Table 1: Fertilizer, Manure and Pesticide Application in the Delaware River Watershed

County	Total Fertilizer Use (tons)	Total Nitrogen (tons)	Total Phosphorus (tons)		Manure Application (acres)	Insecticide Application (acres)	Herbicide Application (acres)
Atchison	12,174	3,377	2,597		2,795	21,043	110,325
Brown	8,189	2,227	1,856		2,679	40,694	188,197
Jackson	12,557	4,104	1,081		8,041	11,441	59,477
Jefferson	8,852	3,003	935		8,019	4,696	89,526
Nemaha	12,214	4,109	1,919		9,164	18,727	148,814
Total	53,986	16,820	7,453		30,698	96,601	596,339

Source: Kansas Department of Agriculture website, www.ksda.gov
2002 Census of Agriculture - County Data
National Ag Statistics Service website, www.nass.usda.gov/Census/_Pull_Data_Census

Table 2: Acres of Crops, Hayland, and Livestock in Delaware River Watershed

County	Soybeans	Corn	Wheat	Grain Sorghum		Hayland	Alfalfa		Cattle (all categories, 2006 data)	Hogs (2002 data)
Atchison	55,600	53,000	14,300	3,100		28,000	1,800		31,400	6,084
Brown	106,300	115,600	15,300	2,900		20,500	2,500		36,400	22,054
Jackson	33,700	26,000	14,300	4,800		59,600	4,800		53,700	1,980
Jefferson	40,900	38,500	9,600	3,700		41,000	5,000		43,300	3,175
Nemaha	79,800	82,500	37,600	12,400		34,200	11,100		62,000	90,962
Totals	3 16,300	315,600	91,100	26,900		183,300	25,200		226,800	124,255

Source: National Agricultural Statistics Service, Kansas Farm Facts, 2004 and website, www.nass.usda.gov/index.asp (State and County Data)

of soybeans planted [NASS, "Agricultural Chemical Usage 2005 Field Crops Summary", May 2006]. Other herbicides used widely in Kansas agriculture include acetochlor, metolachlor, 2,4-D and dicamba (often used in a mix with atrazine).

Agricultural Crops and Livestock: The four most common crops planted in the Delaware watershed include soybeans, corn, wheat, and grain sorghum. In 2004, 316,300 acres of soybeans were reported planted in the five counties in which the watershed is located. Corn was reported on 315,600 acres, wheat on 91,100 acres and grain sorghum on 26,900 acres [NASS, Kansas Farm Facts]. In 2004, hayland use included over 208,500 acres in the five counties, with alfalfa grown on 25,200 acres of that total. This data is summarized in **Table 2.**

In 2006, there were 226,800 cattle reported in the five counties in the watershed [NASS, Kansas Farm Facts]. This number varies from year to year, but generally has ranged from 211,000 to 268,000 between 1975 and 2004[Juracek, 2003 and NASS County Data-Livestock]. The number of hogs in the five counties has decreased over the same period, and was reported at 124,255 head in 2002 (**see Table 2**). However, Nemaha County has seen a large increase in hog number in recent years, but much of this increase has been in areas outside the Delaware River basin [Juracek, 2003].

Many of the livestock in the Delaware River region are in large registered confined animal feeding operations (CAFO's), but the majority of livestock are not. Figures from KDHE in April 2007 show that CAFO's, which are monitored by KDHE, are certified to contain approximately 40,500 beef or dairy cattle and approximately 14,400 hogs [Personal communication with Robert Gavin, KDHE Livestock Waste Management Section]. The number of livestock in these confined operations varies from year to year and month to month. However, it is estimated that at least 80% of cattle and 85% of hogs in the region are in small livestock operations, with numbers below those required by the State of Kansas to register and become certified. These smaller livestock operations are not monitored by the State nor required to use any specific waste management practices.

DEMOGRAPHICS

The total population of the five counties in the Delaware River basin has grown approximately 6% since 1990 [U.S. Census Bureau]. However, the distribution of this population growth is not uniform throughout the area. Atchison and Brown Counties have experienced population declines (1% and 7% respectively). Nemaha County's population has remained relatively stable, but Jackson and Jefferson Counties have experienced significant population increases from 1990 to 2005 (17% and 20% respectively).

Population density also varies by county. According to the U.S. Census Bureau, Nemaha County has the least dense population with 15 persons per square mile. Brown and Jackson County's population densities are 19 persons per square mile, and Jefferson County's population density is 34 persons per square mile. The greatest population density is in Atchison County with 39 persons per square mile (see **Table 3**). However, the most densely populated areas in Atchison County are in eastern portions of the county, outside of the Delaware River drainage. There are only a few cities in the watershed that have populations greater than 1,000 persons. These cities include Holton (pop. 3,345), Sabetha (pop. 2,532), Horton (pop. 1,869), Valley Falls (pop. 1,209) and Oskaloosa

Table 3: Population Statistics for Counties in Delaware River Watershed

County	Population 1990	Population 2000	Population 2005 (estimated)	Growth 1990-2005	Population density (persons/square mile)
Atchison	16,932	16,774	16,804	- 1%	39 [1]
Brown	11,128	10,724	10,239	- 7%	19
Jackson	11,525	12,657	13,535	+ 17%	19
Jefferson	15,905	18,426	19,106	+ 20%	34
Nemaha	10,446	10,717	10,443	0%	15

Source: U.S. Census Bureau, 2005 Population Estimates
U.S. Census Bureau, 2000 and 1990 Census Figures

Table 4: Land in Farms, Number of Farms and Average Size of Farms in the Delaware River Watershed

COUNTY	NUMBER OF FARMS	LAND IN FARMS (ACRES)	AVERAGE SIZE OF FARMS (ACRES)
Atchison	619	226,807	366
Brown	591	324,016	548
Jackson	1,099	337,418	307
Jefferson	1,041	279,780	269
Nemaha	1,020	416,500	408

Note: USDA definition of a "farm" - a unit that has expected annual sales of agricultural products of at least $1,000, or of government farm payments of at least $1,000 (National Agricultural Statistics Service, 2006)

[1] Population density of Atchison County reflects heavy density in the eastern part of the county within the City of Atchison (60% of the county's total population). The City of Atchison lies outside the Delaware River basin.

(pop. 1,148). The remainder of the population in the Delaware River Watershed is dispersed in other smaller communities and individual rural homesteads [U.S. Census Bureau data, Answers.com county data]

The size of farms (in acres) and the total number of farms varies from county to county. According to the National Agricultural Statistics Service [NASS, 2002 Census of Agriculture], Brown County has the largest average farm size (averaging 548 acres in size), followed by Nemaha, Atchison, and Jackson counties. Jefferson County has the smallest average farm size (averaging 269 acres). The number of farms in each county is variable as well. **Table 4** illustrates this information.

PERRY LAKE RESERVOIR

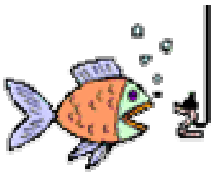
The most outstanding physical feature of the Delaware River watershed is Perry Lake Reservoir on the southern end of the watershed. Perry Lake is a federal reservoir impounded in 1969, and operated by the U.S. Army Corps of Engineers. The project's primary purposes are flood control, navigation support and water supply, but fish, wildlife and recreational benefits are also important uses. Perry Lake's stated purpose includes "to provide an economical and quality program which will afford the public with a diversity of recreational opportunities in harmony with the wise use of the natural resources" (Perry Lake Master Plan, December 1991).

Perry Lake is the fourth largest lake in the state of Kansas. The Delaware River and its tributaries provide inflow for the lake, which has a surface area of 11,146 acres at multipurpose pool elevation (891.5 msl). The dam consists of a rolled earth-fill embankment about 7,750 feet long with an elevation approximately 95 feet above the original streambed. Construction of the dam was authorized by the Flood Control Act of 1954 (Public Law 83-780). Construction started in March of 1964, and the dam was put into operation in January of 1969. Multipurpose pool elevation was reached in June of 1970. Final cost of the construction project was just over $49 million [U.S Army Corps of Engineers website].

The Lake has over 160 miles of shoreline. There are 25,389 surface acres of water at flood control pool elevation (920.6 msl). Flood control provided by the reservoir protects more than three thousand acres immediately downstream from the dam along the Delaware River, and contributes to reductions in flood elevations of the Kansas, Missouri and Mississippi Rivers. Local communities receiving direct flood control benefits include the cities of Perry, Lecompton, Lawrence, Bonner Springs, and Kansas City. Downstream flood damage reductions totaling over $4 billion have been estimated for Perry Lake since operation began in 1969. Perry Lake and the Delaware River basin contribute flows to the Kansas River, which is a major water supply for large populations in eastern Kansas. On average, the Delaware River and its tributaries contribute about 9 percent of the annual flow in the Kansas River [Geiger et al.1994]. A diagram of Perry Lake dam and its water storage

allocations is contained in **Appendix A.**

Portions of the Corps of Engineers project land around Perry Lake are leased to agricultural producers in the area. This allows the Corps to manage a relatively large land area at minimal cost to the government, while realizing some economic gain from rental income and controlling land use immediately surrounding the lake. The more than forty agricultural leases have two primary purposes – to benefit wildlife and to provide soil conservation and water quality benefits through sound agricultural practices. Most leases are set for a length of 5 years and are let on a competitive bid basis.



The Corps of Engineers also maintains recreational facilities around the lake to facilitate camping, fishing, boating, picnicking, hiking and other recreational activities. With 499 campsites, numerous picnicking areas, an extensive trails system and boat ramps, there is ample opportunity to enjoy the lake. Most of the Corps of Engineers recreational facilities are located around the south end and east side of the lake. In addition, the Kansas Dept. of Wildlife and Parks (KDWP) leases land from the U.S. Corps of Engineers for recreational uses. Part of this leased land is contained within Perry Lake State Park on the west side of Perry Lake. This area provides 124 campsites with water and electricity and over 350 primitive camp sites, a swimming beach, beach house, and boat ramps. With such abundant opportunities for recreation, the economic impact of Perry Lake on the adjacent communities is significant. Visitation at Perry State Park and Perry Lake includes more than 700,000 visitor days spent annually in Jefferson County for recreational purposes associated with the reservoir [Jefferson County Comprehensive Plan, 2000].

Perry Wildlife Area on the north end of Perry Reservoir is over 10,500 acres in size. It is land that has been leased by the KDWP from the U.S. Corps of Engineers since 1970 [Kansas Dept. of Wildlife website]. It is operated and managed by KDWP for wildlife benefit and public hunting opportunities. Much of Perry Wildlife Area lies within the Perry Reservoir flood pool, so flooding is common in this area. The area has a diversity of habitats including natural wetlands, oak-hickory woodlands, warm and cool season grasslands, man-made wetlands and several acres of cropland. In the mid-1970's, a complex of eleven man-made marshes were constructed in the Wildlife Area, and two additional marshes were developed in 2000. These man-made marshes provide approximately 1,000 acres of wetland habitat. Water from the Delaware River can be pumped to the Kyle and West River Marsh areas during dry years to maintain migratory bird habitat even in dry periods. All the other wetland areas depend on natural runoff, thus water levels in these marshes vary from year to year. Perry Wildlife Area supports a wide variety of birds, mammals, reptiles and amphibians, including white-tail deer, wild turkey, waterfowl, quail, pheasant, mourning dove, squirrel, rabbit and other non-game species. Trapping and fishing in the Delaware River is also a popular activity in the Wildlife Area. All activities are closely regulated to maintain wildlife numbers and maintenance of the area for future generations.

THREATENED AND ENDANGERED SPECIES

A number of federally listed Threatened and Endangered Species can be found in the 5-county region in which the Delaware River watershed is located. Some of these include the Bald Eagle, Eastern Spotted Skunk, Eskimo Curlew and Redbelly Snake. The area provides critical habitat for

many of these animals. In addition, a large number of species found in the area are listed as "Species in Need of Conservation" (SINC) by the Kansas Department of Wildlife & Parks. These include species such as the Black Tern, Southern Bog Lemming, Plains Minnow and Southern Flying Squirrel. SINC species are non-game species in need of conservation measures in order to keep the species from becoming threatened or endangered. **Appendix B** contains a complete listing of Threatened and Endangered species and of SINC species, as well as more information on these classifications.

There are only two known species of plants found in the Delaware River watershed area that are listed as threatened. Because the State of Kansas does not maintain a list of threatened or endangered plants, these plants are contained on the federal register of threatened and endangered species. They include Mead's Milkweed (Asclepias meadii) and Western Prairie Fringed Orchid (Plantathera praeclara). Both plants can be found in remnant native prairies and meadows or on private prairie hay meadows in the region [Great Plains Nature Center website].

Habitat loss is the greatest cause of endangerment of native animals and plants. Pollution, introduction of new or exotic species that compete with natives for resources, and removal are other reasons for the degradation of native plant or animal populations.

Watershed protection and restoration activities can be very beneficial to threatened plant and animal species. Populations of natives benefit when existing habitat necessary for a species' survival is protected or improved, as in the case of riparian area protection, maintaining native meadowlands, or stabilization of stream banks. Habitat restoration or expansion benefits many wildlife species when native grasses and trees are planted along streams or in fields, thus increasing the area

Eastern Spotted Skunk
Photo by Bob Gress
http://www.kdwp.state.ks.us/news

available to native species for habitat. Improving water quality is an important means of restoring and protecting aquatic species, and has benefits for other wildlife as well.

There are a variety of reasons why native plants and animals should be preserved, ranging from the spiritual to the utilitarian. Just knowing that rare species are present provides satisfaction for the human imagination and experience. All species play important roles in the proper functioning of the food web and some are excellent indicators of environmental health. Future uses of plants and animals in medicine and food production are other reasons why native populations should be preserved.

Listing species as threatened, endangered, or as in need of conservation provides protection for native populations of these species. It brings into play recovery plans that guide research and management aimed at enhancing the listed species' populations. The ultimate goal is to be able to remove a species from their threatened or endangered status. Watershed restoration and protection, while not driven by the goal of restoring threatened populations, is one way in which the protection of threatened and endangered species can be significantly enhanced. The Kansas Department of Wildlife & Parks has developed a "Kansas Comprehensive Wildlife Conservation Plan" (KCWCP) that can be utilized when designing watershed protection practices that will benefit endangered wildlife and plant populations. For more information on the KCWCP, visit the KDWP website at www.kdwp.state.ks.us/news/other_services/wildlife_conservation_plan.

IMPAIRED WATERS IN THE DELAWARE RIVER WATERSHED

Water quality standards for Kansas are established by the Kansas Department of Health and Environment (KDHE) [K.A.R. 28-16-28b through 28g]. These standards represent the quality of water that is necessary to fully support the designated uses of classified streams, lakes and wetlands throughout the state. Specific designated uses, such as domestic water supply, primary contact recreation (swimming), secondary contact recreation (wading, fishing, etc.), and other uses, are assigned to classified water in the state. **Appendix C** has a complete listing of streams and rivers in the Delaware watershed along with their designated uses. When water quality standards are NOT met, a water body and its use(s) are considered impaired. States are required to develop a list of impaired waters, commonly referred to as a "303(d) list", so named after Section 303(d) of the federal Clean Water Act of 1972. The state is required to establish a Total Maximum Daily Load (TMDL) for such impaired water bodies. More information on TMDL's can be found on the Kansas Department of Health & Environment website at www.kdheks.gov/tmdl/index.htm.

303(d) LISTED WATERS IN THE DELAWARE RIVER WATERSHED

A water body is considered impaired and put on the Kansas 303(d) list when it meets one of two criteria: 1) the current water quality does not meet the numeric or narrative water quality standard, OR 2) the designated use for that water body is not being achieved. Every two years, states are required to submit a list of impaired waters to EPA. Although in a similar state of impairment as TMDL water bodies, waters that are on the 303(d) list have not risen to the level of a TMDL stream

or lake in terms of enforcement and protection. It could be said that waters on the 303(d) list are on their way to establishment of TMDL's unless water quality improvements are made, however. **Table 5** lists all 303(d) listed waters and their respective impairment in the Delaware River watershed. Note that the largest impairment (in terms of area) on this list is eutrophication resulting from excessive nutrient loading, and that Perry Lake is on this 303(d) with eutrophication impairment. Zinc and copper contamination in the Grasshopper Creek (a.k.a. the Little Delaware) watershed also creates impairment. Potential sources of zinc include corrosion of galvanized structures and pipe, fertilizers, landfill leachate or industrial wastes. Copper is also used for algae control in lakes and ponds. High concentrations of zinc and copper are generally not toxic to humans (although zinc can lend a metallic taste to water). However, zinc and copper are toxic to aquatic organisms at high concentrations and low water hardness [EPA Secondary Drinking Water Standards].

Table 5: List of 303(d) Waters in the Delaware River Watershed

Water Body Name	Impairment		Water Body Name	Impairment
Streams/Rivers			**Lakes/Wetlands**	
Grasshopper Creek watershed	Zinc, Copper		Atchison County Park Lake	Eutrophication and Sediment
			Perry Lake and Delaware River watershed	Eutrophication
			Perry Wildlife Area	Eutrophication and Low Dissolve Oxygen

Source: KDHE website: http://www.kdheks.gov/tmdl/methodology.htm
EPA website:
http://www.oaspub.epa.gov/pls/tmdl/huc_pt.control?p_huc=10270103&p_huc_desc=DELAWARE&p_cycle=2004

TMDL's IN THE DELAWARE WATERSHED

The state is required to establish a Total Maximum Daily Load (TMDL) for impaired water bodies. TMDL's specify the maximum amount of the pollutant(s) causing impairment that a water body can receive from all pollutant sources and still be able to meet water quality standards and support its designated use(s). In establishing a TMDL for a stream or lake, the state must determine the specific pollutant(s) causing the water quality impairment, the degree of deviation from the applicable water quality standard that exists, and the level of pollution reduction needed to achieve compliance with the water quality standard. The pollutant load determined by the TMDL is allocated between both point and non-point pollutant sources in the water body's watershed. TMDL's must be approved by the U.S. Environmental Protection Agency (EPA).

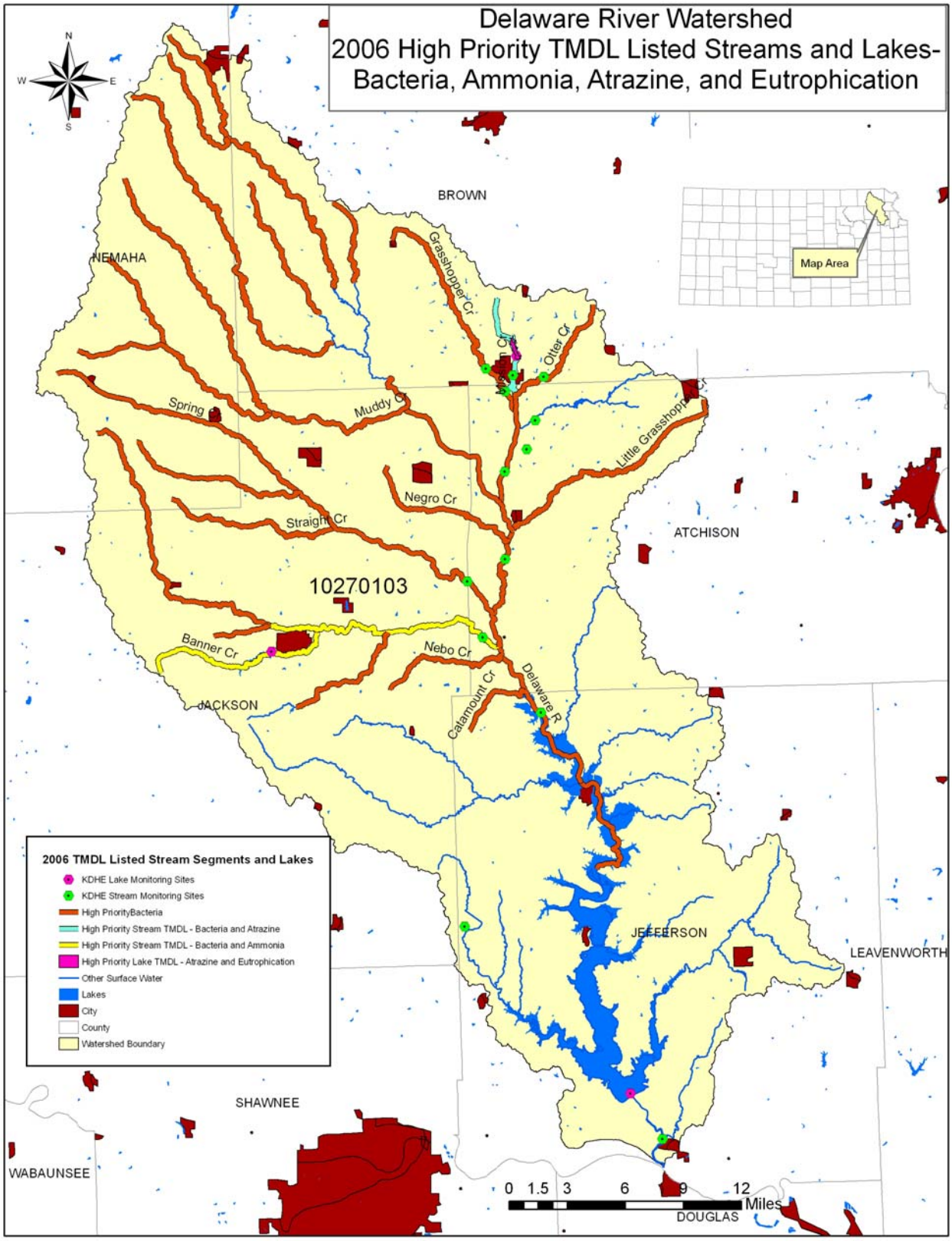
TMDL's have been established for many streams and lakes in the Delaware River watershed. There are 637 miles of classified streams in the basin (generally speaking "classified streams" are larger streams and rivers in the watershed with recognized names). As many as 511 miles of those streams (80%) are impaired and have an EPA approved TMDL. Most of these TMDL's are designated "High Priority for Implementation", and involve four different pollutants: Fecal Coliform Bacteria, Eutrophication (nutrient enrichment), Ammonia, and Atrazine. In addition to these streams, a High Priority TMDL exists for Mission Lake just north of the City of Horton for both Eutrophication and Pesticide impairments. There are also "Low Priority for Implementation" TMDL's established for Eutrophication in two smaller lakes in the watershed - Little Lake near Horton and Sabetha Watershed Pond. The map on the next page shows the location of all High Priority TMDL's in the watershed. Following is a description of the four types of TMDL's in the Delaware basin.

***Fecal Coliform Bacteria*:** Water quality impairment from **fecal coliform bacteria** (FCB) is the most widespread and significant impairment in the Delaware River Basin. TMDL's for FCB, approved in 2000, include the Delaware River and most of its tributaries above Perry Lake, as well as Grasshopper Creek.

Fecal coliform bacteria are present in the intestinal tracts of all mammals and have long been used in water quality monitoring as an "indicator organism". This is because the presence of FCB in water indicates that fecal material is present in the water. While FCB themselves may not be harmful to human health, other pathogenic and potentially harmful organisms are also likely to be found when FCB's are present. Potential sources of fecal bacteria contamination include wastewater treatment plant discharges, livestock wastes, discharges from failing on-site wastewater systems, and wildlife wastes. *E. coli* Bacteria has recently replaced fecal coliform bacteria as the indicator for pathogen pollution under current state water quality standards. About 80% of FCB are *E. coli* Bacteria, on average, in northeast Kansas.

Natural eutrophication is a process in which all lakes, ponds and wetlands gradually age and become more productive over time. Normally it takes hundreds or even thousands of years for this aging process to take place. **Cultural eutrophication** is an accelerated aging process when ponds and lakes receive high amounts of nutrients (primarily nitrogen and phosphorus) from human sources. These extra nutrients stimulate excessive aquatic plant growth resulting in algae blooms. The growth of desirable aquatic vegetation can actually tie up nutrients, acting as a nutrient sink. But when nutrient levels overload the system, they cause algae blooms which result in problems such as taste and odor in drinking water, increased water treatment costs, and loss of recreational value. Toxins produced by blue green algae blooms can be toxic to humans or animals. Algae blooms can also greatly reduce oxygen levels in water when large amounts of dead aquatic plant material decompose, negatively impacting aquatic animals, and frequently resulting in fish kills.

Eutrophication:
Aquatic plant life is the basis of the aquatic food chain, and is very important to the health of any aquatic ecosystem. Like plants that grow on land, aquatic plant growth in water is limited by the availability of plant nutrients, especially nitrogen and phosphorus, and by sunlight and other factors. The addition of nutrients to water from human activity in the


Delaware River Watershed
2006 High Priority TMDL Listed Streams and Lakes-
Bacteria, Ammonia, Atrazine, and Eutrophication
N
W
E
S
BROWN
NEMAHA
Map Area
Grasshopper Cr
Otter Cr
Spring
Muddy Cr
Little Grasshopper Cr
Negro Cr
Straight Cr
ATCHISON
10270103
Banner Cr
Nebo Cr
Delaware R
Catamount Cr
JACKSON
JEFFERSON
LEAVENWORTH
SHAWNEE
WABAUNSEE
DOUGLAS
0 1.5 3 6 9 12
Miles
2006 TMDL Listed Stream Segments and Lakes
KDHE Lake Monitoring Sites
KDHE Stream Monitoring Sites
High PriorityBacteria
High Priority Stream TMDL - Bacteria and Atrazine
High Priority Stream TMDL - Bacteria and Ammonia
High Priority Lake TMDL - Atrazine and Eutrophication
Other Surface Water
Lakes
City
County
Watershed Boundary

watershed can stimulate large amounts of algal growth that leads to eutrophication problems in many lakes and ponds in Kansas.

A high priority TMDL for eutrophication was established for Mission Lake in 2000. In addition, a low priority TMDL for eutrophication was established for Little Lake (a small impoundment located just below Mission Lake) and Sabetha Watershed Pond just south of the City of Sabetha.

Pesticides: Pesticides are chemicals used to control weeds (herbicides), insects (insecticides), fungi (fungicides) and other pests in crops, lawns, golf courses, homes, mosquito control and other applications. Pesticides have provided us with many benefits including increased food supplies worldwide, lower disease rates and more comfortable lifestyles. However, pesticides can be harmful when they find their way into water and the air. Heavy or improper use of pesticides increases the risk of these chemicals dispersing into the environment to places where they don't belong. Pesticide contamination of water is an increasing concern, especially in agricultural areas. Pesticide contamination is particularly a concern related to drinking water supplies due to the human health risks and costs associated with clean-up.

A high priority TMDL for the pesticide atrazine, one of the most widely used herbicide in the Midwest, was established for Mission Lake in the year 2000. This TMDL, along with other quality and quantity concerns, resulted in the abandonment of Mission Lake as a drinking water supply for the City of Horton.

Ammonia: Ammonia is a chemical toxic to fish and other aquatic organisms. The toxicity of ammonia increases at higher pH levels and high water temperatures. Sources of ammonia include municipal and industrial wastes, livestock wastes, failing on-site wastewater, and fertilizer.

A TMDL for ammonia in Banner and Elk Creeks near the City of Holton was approved in April of 2000 based on pollutant modeling data. Modeling of waste loads from industrial and municipal wastewater discharges showed that impairment to aquatic life from elevated ammonia concentrations in these streams would occur at low stream flows. In other words, ammonia levels in the stream were anticipated to exceed levels safe for aquatic life under dry conditions when natural stream flow was low and wastewater discharge was responsible for the majority of the water in the streams. Little impact from other non-point pollution sources is expected. There are two National Pollutant Discharge Elimination System (NPDES) permitted wastewater facilities which discharge wastes to each of these stream segments. They include Oldham's Industries (operating under an industrial program NPDES permit) and the City of Holton (operating under a municipal program NPDES permit). This TMDL is being dealt with through wastewater permitting requirements for the two NPDES permits.

National Pollutant Discharge Elimination System (NPDES) was established by the federal government to control point source discharges of water pollution. Authorized by the 1972 Clean Water Act, it is a permit program that controls water pollution by regulating the type and amounts of pollutants that can be discharged into the waters of the United States. Industrial, municipal and other facilities that discharge wastes must obtain permits that require pollution control of any wastes discharged. In Kansas, the program is administered by the Kansas Department of Health & Environment.

WATER QUALITY CONCERNS IN THE DELAWARE RIVER WATERSHED

IDENTIFYING WATER QUALITY CONCERNS

One of the first things necessary for development of a Watershed Restoration and Protection Strategy (WRAPS) plan is to identify major water quality concerns in the watershed. The process of identifying and prioritizing water issues in the Delaware basin began in December 2005 with the first of many public meetings. Over the course of several months, local stakeholders engaged in a series of discussions that resulted in an extensive list of water quality concerns. Existing water quality data was researched and compiled for the watershed to aid stakeholders in determining what water concerns are supported by the available data. This process allowed the stakeholder group to broaden their overall understanding of local water quality problems. It also resulted in the following:

- ***Identification of data gaps*** – Identification of some issues as true problems, their sources and pinpointing where problems were most severe was sometimes difficult because the data to support definitive conclusions was lacking or inconclusive. These gaps can be filled by additional monitoring and modeling or, in some cases, compilation and analysis of data that does exist but that is not in a format that could be easily used for comparison and decision-making.
- ***Comparison of perceptions of water quality problems to water quality data*** – Individual perceptions of watershed problems are not always supported by facts. Some issues may seem to be larger or smaller problems than they actually are, depending on the amount of information an individual may have. In some cases this may be because of data gaps, or simply because the perception does not fit reality. In other cases, issues that were not considered significant were shown by available data to indeed be serious problems.
- ***Stakeholders' awareness of water quality problems was expanded*** – As various water quality concerns were addressed, individuals who were unaware of some issues, or who had narrow interests in water quality, were exposed to a whole range of concerns, thus broadening their awareness.
- ***A "big picture" view of the whole watershed developed*** – Rural/urban, natural/human, and private/public interests and impacts on water quality problems were explored. How each element affects specific areas within the watershed, impacts on surface versus groundwater, along with economic and social factors at the root of individual issues were also explored. A more holistic understanding of the social, cultural, economic, scientific and historic factors impacting the watershed emerged.

After months of discussion and examination of the data, a better understanding of the status of water quality in the Delaware Watershed began to take shape. This allowed stakeholders to compile a list of seven (7) major water quality issues on which to concentrate their efforts. Although identified as seven unique issues, there is often a great deal of overlap between issues. For example, fecal coliform bacteria is an issue that frequently is related to nutrient management issues, which is also related to sedimentation. A discussion of the seven priority water quality issues facing the Delaware River watershed follows.

THE SEVEN MAJOR WATER QUALITY ISSUES

One of the major outcomes of stakeholders meetings in 2006 was the development of a list of important water issues for the basin. These issues represent the major water quality problems that stakeholders believe should receive priority during the implementation phase of WRAPS. These issues and reasons for their importance in the Delaware River watershed are discussed here. The issues are listed in order of priority, as determined by stakeholders in the watershed. How these issues were prioritized is discussed later in this document.

(1) Sedimentation

The natural process of succession (the progression of an aquatic ecosystem to a terrestrial ecosystem) occurs as sediment is deposited in lakes and ponds over time. Lakes eventually fill with sediment to the point that they become marshes and finally dry land with a stream once again flowing through it. This process usually takes many years to run its course. However, the rate at which it occurs is dependent on various characteristics of the watershed itself and land uses within the watershed. Human activity in the watershed of a lake or pond tends to accelerate this process, causing rapid aging of lakes. Cultivation of cropland, poor grazing practices, construction activity, and removal of trees or other vegetation along stream banks all increase the amount of sediment that is sent downstream into lakes and ponds. Once in the lake, sediment settles to the bottom, reducing the water capacity of the lake, causing it to become progressively shallower. In many cases, sediment also has other materials attached to it such as pesticides and phosphorus that pollute the water of lakes and ponds.

Soils in the Delaware Watershed are agriculturally very productive. Approximately 35% of the area is under cultivation and used to produce crops. Crop production exposes soils to erosion because the soil surface is not protected by permanent growing vegetation at all times, and is frequently disturbed for planting, cultivation and weed control. Overgrazing pastures, home and road construction and other activities also make soil vulnerable to erosion. Soils in the watershed also tend to have low permeability, increasing the susceptibility of the soil to water erosion whenever heavy rainfall occurs. Heavy and sudden thunderstorms are a frequent occurrence in northeast Kansas, and rainfall amounts often exceed the rate at which the rain can infiltrate into the soil. The rain that does not soak in has nowhere to go but downhill, increasing in volume and velocity, picking up sediment along the way. Eventually runoff transports sediment and other pollutants to lakes and ponds. As the water slows, it drops its load, filling ponds and lakes with the sediment that has been transported from fields, pastures and banks upstream.

Perry Lake Sedimentation:
Sediment deposition studies by the U.S. Geological Survey (USGS) show that sedimentation rates in area lakes are high [Juracek, 2003]. A bathymetric survey (survey of depth and lake floor elevations) and bottom-sediment coring study of Perry Lake in 2001 estimated that the total volume

of bottom sediments deposited from 1969 (when the lake was constructed) to 2001 was 2,470 million cubic feet. An average of 2,740,000 pounds of sediment per square mile (slightly more than 2 tons/acre) had been transferred to Perry Lake from the watershed annually. The USGS estimates that sediment now occupies about 23% of the original water storage capacity of the lake. Although constructed with a design life of 100 years, Perry Lake may fall short of its planned life expectancy if these figures are accurate. This not only means the premature loss of a recreational, wildlife and navigational resource, but it also becomes a serious water quantity issue. Current and future uses of the lake as a public water supply are in jeopardy from the loss of storage capacity to sedimentation.

The U.S. Army Corps of Engineers is more optimistic about the rate of sedimentation in Perry Lake. The Corps regularly monitors sediment inflow to all lakes that it operates. Their most recent survey of Perry Lake was completed in May 2001 [personal communication from Steve Fischer, USACE] and showed that after 32 years of operation, 39% of the sediment storage capacity – or 15% of the original water storage capacity – of Perry Lake was filled with sediment. Federal reservoirs like Perry Lake have sediment storage designed into their construction (see diagram in **Appendix A**). According to the Corps, sedimentation rates thus far are not significantly greater than what is anticipated over the 100-year design life of the lake. Large reservoirs such as Perry have higher rates of sedimentation in the early years of the lake's life. Lakeshore sloughing and stream bank erosion in river channels immediately upstream of the lake take place as the area adjusts to frequent flooding and backwater impacts of the dam. As the surrounding landscape and stream channels adjust to the hydrodynamics introduced by the dam, sedimentation rates should decrease. Thus it is possible that much of the sediment in the bottom of Perry Lake arrived there early in its life.

Although there is debate as to how fast Perry Lake is filling with sediment, aerial photography provides an interesting perspective. A series of six satellite photos of the upper end of the lake from 1974 to 2001 (courtesy of the Kansas Biological Survey) in **Appendix D** show the visible, rapid sedimentation occurring in this area. More surveys in the future should help us better understand the rate of sedimentation taking place in the main body of the lake.

The fate of Perry Lake depends heavily on future conditions in the watershed. Large floods on the scale of those seen in 1973 and 1993 bring in large amounts of sediment. On the other hand, drought such as what has been experienced in the watershed in the past 4 years, results in smaller than normal amounts of sediment delivered to the lake. Changes in land use and implementation of erosion controls will also have an impact. Construction of watershed dams, grade stabilization and floodwater retention structures could have a large impact on sedimentation rates. For example, it was estimated that full implementation of the Delaware #10 and Nemaha-Brown #7 Joint Watershed Districts' conservation plans, involving the construction of hundreds of watershed dams and other structures, was expected to extend the useful life of Perry Lake by 25 years [Letter by Philip L. Rotert, Planning Division Chief, U.S. Army Corps of Engineers, October 7, 1982]. Only 25% or less of the planned structures in these watershed districts have been built because of funding cuts. Resumption of watershed structure construction in the watershed could have an impact on sedimentation rates in Perry Lake. There is, however, controversy about whether dams create "hungry water" as silt-carrying capacity of streams is increased downstream from dams.

It is important to note that even after Perry Lake's sediment reserve space is filled, flood control benefits and water supply allocations will be available. Nevertheless, it is of great importance to economic, recreation, aesthetic and other interests to try to preserve Perry Lake as long as possible.

Mission Lake Sedimentation:

Mission Lake near the City of Horton has experienced a fate similar to that of Perry Lake. Its watershed is 77% cropland, and also has soils with slow permeability rates susceptible to high runoff and erosion. Built in 1924 with horse and drag line equipment, the lake had an original surface area of 169 acres, storage capacity of 1,866 acre-feet of water and an average depth of 11 to 12 feet [B.G. Consultants, 2004]. By 1954, the lake's storage volume had been reduced to 1,188 acre-feet and the average depth of the lake was only 7.7 feet. A study of the lake in 2004 showed a lake surface area of only 71 acres (58% reduction since construction), storage volume of only 493 acre-feet (74% reduction), and an average depth of 6.95 feet. The lack of capacity and low quality water in Mission Lake forced the City of Horton to discontinue use of the lake as a drinking water source and rely exclusively on six off-site wells as their primary water supply. However, these wells do not have capacity to meet current and projected future needs of the City.

These studies of sedimentation in two major lakes in the Delaware River basin lend credence to conventional wisdom and anecdotal stories area residents tell of what local ponds were like years ago compared to today. Residents recall ponds that were once clear and deep, but which are now shallow and murky. The demise of lake resources due to sedimentation has ramifications for all issues that are water-related, not the least of which is supplying adequate water for the future needs of Kansans. The Delaware River, its tributaries and Perry Lake are important to maintaining adequate stream flows for the State's largest population centers along the Kansas River, and as a future supply of water for growing populations in eastern Kansas. Loss of water storage capacity here forces future populations to look further and further away for adequate water to supply human needs, and puts increasing pressure on wildlife, recreational and navigational water uses as well.

Sources of Sedimentation:

Many resources have been expended in an effort to reduce soil erosion and the water quality impacts of sediment. Erosion from cropland and pastures has been addressed with many programs to install soil-saving structures like terraces, waterways, and grade stabilization dams over the years. This was obviously necessary to protect soil resources and ensure continued agricultural productivity. More recently, attention has focused on reducing the negative impacts sediment has on water quality and on extending the life of lakes and reservoirs impacted by sedimentation. Because the focus is now on issues related to water quality and sedimentation, the question of just where eroded sediment is coming from must be answered. Is the majority of the sediment continuing to come from surface soil eroded from cropland fields, pastures and other areas, or is it coming from the erosion of stream channels and banks? Unfortunately, we know very little about the answer to this question even though this information is essential to designing effective strategies to reduce sediment loads in streams and rivers.

A recent study of the Perry Lake basin by the U.S. Geological Survey (USGS) attempted to address the question of where sediment in area reservoirs originates [Juracek and Ziegler, 2007]. Five sub-watersheds in the Delaware River basin were selected for study including Atchison County Park Lake and Mission Lake in the northeast, Banner Creek Lake in the west, Gregg Creek in the north and Walnut Creek in the southeastern part of the basin. Both surface soil samples and stream bank samples were taken in each of the sub-watersheds. In addition, the banks of the Delaware River were sampled at three different locations. Reservoir bottom sediment samples were also taken from sub-watershed lakes and from Perry Lake.

The chemical composition of surface soils tends to differ from that of stream banks in several ways,

so these differences were used to determine sediment source. Total organic carbon, total nitrogen, total phosphorus, and Cesium-137 (a metal most commonly found in the environment as a result of fallout from nuclear weapons testing in the 1950's and 1960's) were the main constituents the study examined to determine sediment origination points.

Results of this USGS study showed that source of sediment in the bottom of reservoirs varies from one sub-watershed to the next. Atchison County Park Lake sediment sources tend to be surface soils, but sediment sources for nearby Mission Lake were predominantly stream channel banks. The sediment source for Banner Creek Lake was also primarily stream banks. For Perry Lake overall, stream banks were probable predominant contributors. This was an interesting study, but many factors cause some uncertainty about its results. Shoreline erosion around lakes may contribute sediment that mimics stream bank sources upstream, and the small number of samples used to characterize surface soil and stream bank sources complicates a strict interpretation of the study results. However, it seems evident that different parts of the Delaware River watershed have different types of sedimentation and erosion problems. An effective strategy to reduce erosion and in-stream sediment loads will require careful study of sub-watersheds within the basin, and measures to address sedimentation should be customized in each to address the predominant sediment source. A great deal of additional research is needed.

(2) Nutrient Management

A look at many ponds and lakes in the Delaware watershed in the summer reveals a common problem – algae blooms. Algae blooms, heavy pond weed growth, and lush shoreline vegetation are symptoms of excessive nutrient loading (primarily nitrogen and phosphorus). Not only is this a nuisance, but it can be detrimental to aquatic life, and reduces the life expectancy and value of ponds and lakes. Blue green algae blooms may produce toxins dangerous to animals and humans, and also increases water treatment costs when the water is used for drinking.

One source of excess nutrients that causes these problems is fertilizer used on cropland, pastures, and on urban lawns and golf courses that is carried in runoff or attached to eroded sediment. Livestock wastes deposited when animals spend time in streams and ponds, or that is washed into streams from livestock feeding sites and improper waste disposal also contribute to the problem. In addition, untreated wastes from failing on-site wastewater systems (such as septic tanks and lagoons) can be a source of nutrients to streams. Discharges from public wastewater treatment facilities may also contribute, although these facilities must meet treatment requirements to operate under state-issued permits and should not cause excessive loading in most cases.

Table 6 shows a comparison of nitrogen and phosphorus levels in the surface waters of the Delaware basin to those statewide and those recommended for aquatic life support. Nitrogen has a numerical water quality criterion for drinking water, but other criterion for nitrogen and phosphorus are narrative.

Eutrophication is part of the natural aging process that lakes undergo when nutrients delivered to the lake cause aquatic plant growth and increased plant productivity over time. This process is greatly accelerated when human influences in the watershed cause excessive nutrient enrichment of lakes and ponds. Algae blooms are a characteristic of lakes and ponds that are experiencing this type of eutrophication.

Table 6: Delaware River Watershed and Statewide Averages of Nitrogen and Phosphorus

Nutrient	Delaware River Watershed Average Concentration	Statewide Average Concentration	Water Quality Numerical or Narrative Criterion
Nitrogen	1.44 mg/l in surface water 1.71 mg/l in groundwater	1.02 mg/l surface water 4.9 mg/l groundwater	MCL for drinking water = 10 mg/liter; Concentration >1 mg/liter indicates eutrophic conditions in lakes; EPA proposed Ecoregional Nutrient Criteria = 0.36 mg/l
Phosphorus	0.27 mg/l	0.26 mg/l	EPA recommendation to protect aquatic life in streams = <0.10 mg/l; Concentration >0.05 mg/l in lakes indicates eutrophic conditions EPA proposed Ecoregional Nutrient Criteria = 0.02 mg/l

Source: KDHE, Kansas Nonpoint Source Pollution Management Plan - 2000 Update, Dec. 2000.
KDHE, 2006 Kansas Water Quality Assessment (305(b) Report), April 2006.

Algae are aquatic plants containing the pigment chlorophyll *a*. Algae growth increases in response to added nitrogen and phosphorus, thereby producing more chlorophyll *a*. Measuring chlorophyll *a* concentrations in water is one simple way to gauge the level of nutrient enrichment in a lake or pond. This measurement can also be used to determine a lake's trophic state, or its level of aquatic productivity.

Mission Lake Eutrophication TMDL:
Mission Lake has a high priority TMDL for Eutrophication, a result of heavy inputs of nutrients from the watershed of the lake. Water quality data used to establish this TMDL cited chlorophyll *a* concentrations that were consistently elevated, averaging 21.1 parts per billion (ppb). This is related to a Trophic State Index (see text box on the next page) measurement of 60.5, indicative of very eutrophic (very nutrient rich) conditions. The goal of the Mission Lake TMDL is to reduce chlorophyll *a* concentrations to less than 12 ppb (Trophic State Index level of <50, indicating slightly eutrophic condition) by reducing phosphorus inputs from the watershed [KDHE website, Kansas-Lower Republican Basin TMDL's]. Mission Lake is also shallow and tends to have high turbidity. Re-suspension of sediments containing nutrients within the lake recycles nutrients to aquatic plants. Because this is a source of nutrients present within the lake itself, simply reducing inputs of nutrients from the watershed alone may not be sufficient to significantly reduce the trophic state of the lake.

The TMDL for Eutrophication in Mission Lake was approved on January 26, 2000. This TMDL was developed using data from Lake Monitoring Program records from the years 1989, 1994, 1996, 1997 and 1998. More recent water quality data sheds additional light on the water conditions of this lake. According to the KDHE "Lake and Wetland Monitoring Program 2002 Annual Report", the lake was classified as "argillotrophic" based on samples taken during the year 2002. Argillotrophic status is a special category describing a state of high turbidity due to suspended clay

Trophic State Index (TSI) is a way of gauging the level of nutrients in a lake based on water clarity and frequently chlorophyll *a* levels in the water. It indicates the range of uses a lake has, such as its suitability for swimming. There are 4 broad trophic categories:
Oligotrophic: very low in nutrients, clear water, few algae (TSI value < 40)
Mesotrophic: moderate level of nutrients and productivity, slightly greener water (TSI value 40 – 49.9)
Eutrophic: high level of nutrients and productivity, murky water and/or lots of aquatic plants (TSI value of 50 – 63.9)
Hypereutrophic: very high level of nutrients, water clouded with algae (TSI > or = 64)

particles in the water column that restrict the amount of light available to phytoplankton (algae) and macrophyte (submerged water plants) communities in the lake. In argillotrophic lakes, nutrient levels generally are quite high, but this high nutrient availability is not fully translated into high algal production due to limitations on availability of sunlight caused by the suspended soil particles in the water. Aquatic plants such as algae require sunlight to grow, just as terrestrial plants do. Any limitation on sunlight available to these water plants will decrease the amount of plant material that is produced.

Argillotrophic lakes experience chronic high turbidity and limited availability of light to aquatic plants because of constant re-suspension of sediments by wind and/or benthic feeding fish (bottom feeders such as carp that stir up bottom sediments as they feed). Argillotrophic lakes may also experience sporadic high turbidity levels following storm events that flush large amounts of sediment into the lake from erosion in the watershed, or that also stir sediments present in the lake with a large influx of runoff.

In the case of Mission Lake, it appears that the shallowness of the lake is the main contributor to its argillotrophic state. Recent bathymetric surveys (survey of depth and lake floor elevations) of the lake bottom indicate that the average depth of the lake is less than 7 feet (average depth was 11-12 feet after construction in 1924). The surface area of the lake has diminished from the original 169 acres with water storage capacity of 1,866 acre-feet after construction, to just 71 acres of surface area with water storage capacity estimated to be about 493 acre-feet. [BG Consultants, Potential Water Quality Enhancement Strategies, Mission Lake, Horton, Kansas, July 2004] This dramatic reduction in depth, surface area and storage capacity is evidence of the undeniable fact that the lake has filled with sediment**.**

Preliminary results of the KDHE 2006 Lake Monitoring Program indicate that Mission Lake was somewhat less nutrient rich, slightly clearer and somewhat greener [personal communication from Ed Carney, KDHE, September 2006] than was seen in prior surveys. The lake was classified as "very eutrophic", with diminished light availability exerting some secondary influence on the lake's overall algal production. Any changes in the lake's trophic condition were attributed to the drought conditions in the watershed during 2006. However, lake conditions still included high nutrient availability and turbidity in this 2006 study.

Mission Lake has a watershed area of just 8.6 square miles, the majority of which is in cropland production. The implementation of conservation practices in this watershed area has been dramatic in the past several decades. The watershed is fully terraced, has multiple small impoundments that trap sediment and is an area in which no-till practices are used extensively. The Natural Resources Conservation Service (NRCS) considers the area fully treated for erosion control [personal

communication, Matt Sprick, Brown County NRCS District Conservationist], with soil erosion rates from cropland at levels below tolerable soil loss levels. Since the plant nutrient phosphorus tends to be transported with sediment, there has been reduced external phosphorus loading to Mission Lake in recent years from erosion sources due to the soil conservation measures. Thus, internal nutrient cycling or nutrient sources other than cropland erosion and fertilizer are likely to be contributing to algae bloom problems in the lake.

What to do about Mission Lake's condition has been a dilemma for the City of Horton as well as surrounding residents for years. The City hired B.G. Consultants, Inc. in 2004 to examine alternative management options for the lake. Potential solutions provided by B.G. Consultants included chemical treatment for algal blooms, dredging, doing nothing and several other alternatives [B.G, Consultants, 2004].

At the current time, the City of Horton is seeking funding assistance to dredge Mission Lake. The reason the City has chosen this alternative is based on its need for additional water to meet future needs. Although an expensive solution, dredging the lake and removing accumulated sediment has the potential to reduce internal nutrient recycling, will increase water storage capacity, and should improve overall water quality conditions. In the short run, however, dredging will cause temporary re-suspension of sediment and may release nutrients and other pollutants buried with the sediment. Disposal of large volumes of dredge material may also be problematic. The B.G. Consultants report estimates the cost of dredging Mission Lake (at $3.00 per cubic yard) to be $6.6 million.

***Fish and Macroinvertebrate Indicators*:**

The Kansas Department of Wildlife and Parks (KDWP) Stream Monitoring and Assessment Program studies biological components of streams in the state. The presence and abundance of different species of fish and macroinvertebrates (animals without backbones that are large enough to be seen with the naked eye, for example snails, crayfish and aquatic insects) have been used as indicators of impact from various pollution sources and the relative health of streams.

The Sub-Watershed Report issued by KDWP in February, 2006 for the Delaware River basin compiled information from stream assessment surveys from 1994 through 2004. Biological organisms found in these assessments indicate that the Delaware River and its tributaries are highly impacted by nutrient and oxygen demanding pollutants. This conclusion is based on an average Macroinvertebrate Biotic Index (MBI) value for the Delaware basin of 6.69. This MBI rating is interpreted using the following scale [KDWP, Feb. 2006]:

- MBI < or = 4.5 No impact from nutrient and oxygen demanding pollutants
- MBI 4.51 - 5.39 Moderate impact from nutrient and oxygen demanding pollutants
- MBI > or = 5.4 High impact from nutrient and oxygen demanding pollutants

Fish study information is also presented in this Sub-Watershed Report. The Index for Biological Integrity (IBI) scores for the samples showed the stability of fish communities in the watershed were in the "fair" to "good" range. These scores are based on a method using 12 metrics that combine many different biological factors from fish sampled [KDWP, February 2006]. The entire KDWP Sub-Watershed Report for the Delaware River watershed and other watersheds in Kansas can be accessed from the Kansas Alliance for Wetlands and Streams (KAWS) website at www.kaws.org/Hot_Topics.htm.

Nutrient Enrichment of Perry Lake:

The nitrogen (N) to phosphorus (P) ratio in surface water is another relative measurement of nutrient loading to surface water. In most freshwater environments, phosphorus is the limiting factor for plant production. If phosphorus levels increase in relation to other nutrients (especially nitrogen) and other factors necessary for aquatic plant growth, algal growth will increase and may become excessive. Generally speaking, a ratio of nitrogen to phosphorus that is in the range of 10:1 or lower indicates eutrophic (nutrient rich) conditions that are conducive to large algae blooms. U.S. Army Corps of Engineers water quality sampling of Perry Lake over the past 10 years has examined nitrogen and phosphorus levels within the lake and at lake inflow points [USACE, 2001 data]. N:P ratios of less than 10:1, and as low as 1:1, are very common, indicative of nutrient-rich, eutrophic conditions that result in frequent algae blooms in the lake.

A recent USGS study [Juracek, 2003] studied sediment deposition and nutrient loading in Perry Lake by examining sediment cores. Sediment cores can give a historical record of the deposition of sediments, nutrients, diatoms, and other constituents over time. Sediment core samples from 19 sites within Perry Lake were collected in the summer of 2001. These cores indicated that deposition of nitrogen and phosphorus appears to have been fairly uniform throughout Perry Lake's life. The estimated average net load of nitrogen and phosphorus to the lake was 7,510,000 lb/year and 3,350,000 lb/year respectively. This translates into an average yield of 6,850 lbs./year of nitrogen and 3,020 lbs./year of phosphorus per square mile of land area in the Perry Lake watershed.

In this same study, diatoms found within the sediment cores revealed a potentially positive water quality trend for Perry Lake. Diatoms are microscopic algae that have a siliceous shell (a hard compound containing silicon dioxide also found in quartz and sandstone) that does not break down easily over time. The shells of these organisms that die and settle down to the lake bottom are preserved in sediment, providing a record of what species thrived in the lake and what the water quality conditions were in the past based on the types of organisms that lived there. In this way, changes in diatom species composition and relative abundance are indicators of environmental conditions and changes in the lake. The USGS study found a statistically significant positive depositional trend of oligotrophic (nutrient poor) diatoms and significant negative depositional trend of eutrophic (nutrient rich) diatoms in sediment cores. In other words, the abundance of diatoms that flourish under lower nutrient and organic pollutant levels increased in younger sediments, and the abundance of diatoms that are more tolerant of high nutrient and organic

pollutant levels decreased in more recent sediment deposits. Although eutrophic species have been dominant throughout Perry Lake's history, this trend in diatom species composition tells us that environmental conditions in the lake may be changing in ways that favor less pollution tolerant species, indicative of less nutrient pollution in the lake water in more recent years. It is, however, difficult to determine the exact cause of this change in diatom species. No major decreases in nitrogen, phosphorus or chlorophyll *a* concentrations were noted to explain the trend. Differences noted in diatom species composition may be due in part to other variables, so it is difficult to draw any definitive conclusions from these diatom species trends yet.

(3) Fecal Coliform Bacteria (FCB)

The presence of fecal coliform bacteria (FCB) in water has long been used as a measure or indicator of contamination. Although FCB themselves may not be harmful, their presence in water indicates that fecal material is present, and that disease organisms such as E. Coli, giardia, or others may also be found in the water. Generally speaking, the higher the level of FCB, the greater the level of fecal contamination of the water, and the greater the likelihood of pathogenic organisms being present.

Bacterial contamination of surface water in the Delaware River basin is widespread (see map **page 23**). TMDL's for FCB contamination have been established for the Grasshopper Creek sub-watershed, and for most of the area drained by the Delaware River and tributaries above Perry Lake [KDHE, Kansas-Lower Republican Basin TMDL's, KDHE website]. Bacterial contamination of these streams is at levels high enough that they do not support their designated uses (see **Table 7**). During the period of record (1987, 1990 - 1998) from which the fecal coliform bacteria TMDL's were developed, 24% of the Grasshopper Creek samples, and 29% of the Delaware River watershed above Perry Lake samples exceeded FCB water quality standards.

Bacterial contamination of water in the Delaware basin comes from a variety of sources including livestock wastes, failing on-site wastewater systems (such as septic tanks and lagoons), and wildlife. Discharges from public wastewater treatment plants may contribute to FCB levels as well. A comparison of average FCB levels for the Delaware River watershed to water quality standards, and to statewide averages illustrates the severity of the FCB contamination problem in the Delaware basin. **Table 7** is an illustration of these comparisons.

Livestock Wastes: A significant portion of farm income in the Delaware River watershed comes from the livestock industry. Beef and dairy cattle and swine make up the majority of livestock in the basin (see **Table 2** on page 14). Many of these animals are contained within confined animal feeding operations (CAFO's). CAFO's with more than 300 animal units must register with the Kansas Department of Health & Environment (KDHE) and install runoff and waste control practices that will protect water quality according to KDHE recommendations for the operation. Registered CAFO's are also closely monitored by KDHE. Because of this monitoring and runoff management requirements, registered CAFO's are not considered a significant threat to water resources. Currently, there are approximately 85 registered and/or permitted CAFO's in the Delaware River watershed [KDHE, Livestock Waste Management data, Oct.2006].

More livestock are found in unregistered smaller livestock operations than in CAFO's in the Delaware watershed. Because unregistered operations are not required to have runoff management requirements, are not closely monitored, and represent the largest number of animals in the watershed, these smaller operations may be a significant source of fecal coliform bacteria and nutrients to streams and lakes. Whether or not these smaller operations pose a water quality threat depends on waste management practices and their proximity to water resources.

Human Wastes: Much of the human population of the watershed lives in rural areas not served by public sewer systems. For such households, wastewater is usually disposed of by on-site wastewater systems. Properly designed, constructed and maintained systems are an effective and safe means of wastewater treatment. Since the early 1990's, all counties in the watershed have adopted sanitary codes that provide better oversight of on-site wastewater system construction than in the past. However, many older systems may not be properly constructed or maintained, and may consist of nothing more than a pipe from the house to a ditch or stream. Such systems do not provide sufficient treatment of wastes prior to release to the environment, and are considered to be failing. They can be a significant source of fecal coliform bacteria and other potentially disease-causing organisms, nutrients, and chemicals that are used in the household. There are an estimated 4,300 on-site wastewater systems in the Delaware watershed and their number is increasing [KDHE data, December 2006]. The exact number of failing systems is unknown, but local estimates are that approximately 20% of on-site systems in the watershed are failing.

Human wastes from public sewer systems may at times also be a source of bacterial contamination. Public wastewater treatment plants are regulated under the National Pollutant Discharge Elimination System (NPDES) and must have pollution controls in place to avoid contaminating receiving waters with polluted discharges (see text box on **page 24**). However, when these systems are not operating properly, become overloaded or are old and outdated, some contamination of

Table 7: Delaware River Watershed and Statewide Averages for Fecal Coliform Bacteria

Pollutant	Watershed Average	Statewide Average	Water Quality Standard
Fecal Coliform Bacteria	2,273 col/100 ml	1,422 col/100 ml	0 for drinking water; geometric mean of 5 samples <200 col/100 ml w/ no sample exceeding 900 col/100 ml (primary contact recreation); <2,000 col/100ml (secondary contact recreation)

Source: KDHE, Kansas Nonpoint Source Pollution Management Plan - 2000 Update, Dec. 2000.
KDHE, 2006 Kansas Water Quality Assessment (305(b) Report), April 2006.

Primary Contact Recreation = recreation where full immersion in the water occurs, for example swimming, wading, water skiing, etc.
Secondary Contact Recreation = recreation where partial body contact with water occurs, immersion is unlikely, for example fishing and boating.

water by bacteria and other pollutants is possible. There are 43 wastewater systems in the watershed with NPDES permits, and of those, eight have been cited as in need of system upgrades to meet NPDES permitting requirements [U.S. EPA "Clean Water Needs Survey and communications with KDHE].

Wildlife Wastes: Wildlife can contribute to fecal coliform bacteria levels in water when their numbers are large. Migrating waterfowl congregating in large numbers on area ponds and lakes are an example of a situation where wildlife may be a significant source of bacterial contamination in water. It is not believed that wildlife as a whole is a source of contamination on a consistent basis, although they may be a source of contamination at certain times of the year.

(4) Pesticides

Agriculture is by far the largest land use in the Delaware River watershed. The 2002 Census of Agriculture estimates that 86% of the land area within the 5 counties in which the Delaware River Watershed is located is in farms. At least 35% of the total land area in these counties is cropland, and 51% is pasture or rangeland [NRCS, Rapid Watershed Assessment, December, 2006]. To maximize production, modern agriculture employs the use of insecticides, herbicides, fungicides and other chemicals to control pests. Urban and suburban use of pesticides to control weeds and insects in lawns, on golf courses, in mosquito control programs and other uses is also prevalent. In many cases, the concentration of pesticides used for urban/suburban pest control is much higher than those used in agriculture. Urban, suburban and agricultural uses of pesticides are all potentially significant sources of water contamination in the Delaware watershed.

Establishment of the Nation's First Pesticide Management Area (PMA):
The first inland Pesticide Management Area (PMA) in the nation was established in the Delaware River basin by the Kansas State Board of Agriculture (now known as the Kansas Department of Agriculture) in 1992. Long-term water quality studies of Perry Lake prior to 1992 indicated that average atrazine concentrations were at or above the Maximum Contaminant Level (MCL) for drinking water of 3.0 part per billion (ppb), prompting serious concern for public health (an aquatic life standard of 3 ppb for chronic exposure and 170 ppb for acute exposure had also been adopted for atrazine). The PMA order banned all non-cropland use of atrazine, issued mandatory land management and agricultural practices aimed at reducing atrazine losses to surface water, and initiated a basin-wide education and monitoring program [KDA, Water Quality, Pesticide Management Area, KDA website, October 2006].

Atrazine is one of the most widely used herbicides in Kansas. Even with increasing popularity of other herbicides, atrazine usage remains relatively high with 2,767,000 pounds applied to corn acres alone in 2005 [NASS, "Agricultural Chemical Usage, 2005 Field Crops Summary", May 2006]. Continued use of atrazine in the watershed, slow rainfall infiltration rates in the basin, and atrazine's propensity to be easily transported in runoff water combine to make this herbicide a persistent problem in water (see **Table 8**).

Although considered a drastic move by some, the decision to establish a PMA was supported by several U.S. Geological Survey (USGS) studies of Lake Perry and the Delaware River. Atrazine concentrations showed strong seasonal variations and correlations to application times and climatic factors. Atrazine concentrations found in the Delaware River near Muscotah, Kansas from January

Table 8: Delaware River Watershed and Statewide Averages for Atrazine

Pollutant	Watershed Average	Statewide Average	Water Quality Standard or Recommendation (if any)
Atrazine	**1.64 mg/L**	**1.12 mg/L**	**MCL = 3.0 mg/L (ppb)**

Source: KDHE, Kansas Nonpoint Source Pollution Management Plan - 2000 Update, Dec. 2000.
KDHE, 2006 Kansas Water Quality Assessment (305(b) Report), April 2006.

1989 to February 1990 were smallest in January through April (prior to herbicide application), and largest in May, June and July (after application and during high rainfall periods).

The largest concentration detected was 22 ppb in June, 1989. The average atrazine concentration for the entire 1989 calendar year (based on 16 samples) was 2.8 ppb [Stamer et al. 1995]. Unlike the unregulated upstream reach of the Delaware River, concentrations of atrazine at the outflow of Perry Lake below the dam showed little seasonal variability. Concentrations at the outflow gradually decreased from 5.0 ppb in Jan. 1989 to 1.7 ppb in February 1990, with an average concentration for 1989 at 3.5 ppb (in excess of the federal MCL drinking water limit). A follow-up study in April, May and June of 1990 showed average concentrations of atrazine for these three months were 0.32, 6.7 and 13.0 ppb, respectively. It was concluded that because of the large volume of water stored in the Perry Lake from runoff throughout the year, the lake was acting as a storage reservoir for atrazine. As water was released from the dam over time, the stored atrazine is metered out at levels that are much more stable and at times higher than those of the inflow water during certain times of the year.

Another USGS study conducted from July 1992 through December 1994 resulted in other interesting observations [Pope 1995]. As expected, atrazine concentrations in streams draining into Perry Lake were highest in May, June and July. These three months (25% of the calendar year) accounted for at least 90% of the entire atrazine loading to the lake for the year. Samples taken after heavy rainfall events had the highest spikes in concentration. Drainage from the northern and northeastern parts of the basin (Upper Delaware River north of Muscotah, Grasshopper Creek and Coal Creek) also tended to have the highest concentrations of the chemical. These areas have the highest percentages of cropland in the watershed, thus the highest percentage of acres planted to the crops on which atrazine is used. The concentration of atrazine that was present in the outflow from Lake Perry again differed significantly from that of the unregulated inflow from the Delaware River and its tributaries. Outflow from the lake, measured at a sampling point directly below the dam showed far less fluctuation in concentration than those seen at the upstream sites. This study showed again that the concentration of atrazine at the lake outflow site tends to be delayed, attenuated and persistent when compared to upstream sites. Perry Lake acts like a storage body, providing a constant source of atrazine downstream, to the Kansas River and to downstream water users. Storage time spent in the reservoir concentrates the atrazine brought in from the watershed during the growing season, but it can also provide time during which some atrazine degradation takes place. Peaks in atrazine concentration at the lake outflow point also lagged behind those in the upstream sites, and were just above the MCL of 3.0 ppb in July through December of 1994. Largest monthly average concentrations in the Perry Lake outflow in this study occurred in July 1993 and Aug. 1994, whereas the largest monthly average concentrations at the upstream sites were

noted in June 1993 and July 1994. Near record flooding in 1993 resulted in lower concentrations in the outflow (showing a dilution effect) than in 1994, which by contrast, was a year with limited rainfall.

Measures enacted by the 1992 PMA order have been effective in decreasing the average concentrations of atrazine in Perry Lake below the MCL level [KDA, Water Quality, Pesticide Management Ares, KDA website, October 2006]. However, it's presence in water has not been eliminated. Atrazine and other herbicides, some of which are being used as alternatives to atrazine, continue to be detected in Perry Lake and other lakes in the watershed. For this reason, the PMA order remains in effect in the Delaware River watershed today.

Other Pesticide Monitoring Programs:

The U.S. Army Corps of Engineers maintains a water quality monitoring program for Perry Lake. Samples taken from three locations within the lake and at lake inflow points indicate that atrazine continues to be present in streams flowing into the lake. Although average concentrations do not exceed the 3.0 ppb MCL, individual samples taken following rainfall events during the growing season occasionally show a "spike" in concentration greater than 3.0 ppb. A sample showing a spike of 19 ppb was collected during 2003 from the Delaware River inflow sampling site, while a single spike of 8 ppb was recorded during May 2006 at a site within the lake itself [U.S. Army Corps of Engineers, 2001 and 2006].

Other herbicides have also been detected in Perry Lake waters by the Corps of Engineers sampling program. Alachlor, an herbicide used to control annual grasses in corn, sorghum and soybeans (the three major crops in the Delaware watershed) has also been detected. The U.S. Environmental Protection Agency (EPA) has established an MCL for alachlor at 2.0 ppb for drinking water. Notably, Perry Lake is the only lake in the Corps' Kansas City district to exceed this limit in any one individual sample (samples exceeded this MCL during 1999 and 2000). Similar to atrazine, however, average concentrations of alachlor do not exceed the 2.0 ppb MCL level [U.S. Army Corps of Engineers, 2001 and 2006]. Alachlor, like atrazine, does not bind well to soil particles. It is easily transported by runoff to streams when heavy rainfall occurs soon after application, resulting in concentration "spikes" in Perry Lake inflows.

Maximum Contaminant Level (MCL) = a standard set by the U.S. Environmental Protection Agency (EPA) for drinking water quality, set to protect human health.

The Corps' lake monitoring program has detected the presence of four other herbicides in Perry Lake and lake inflows. These include metolachlor (MCL = 70 ppb), cyanazine, acetochlor and glyphophosate (MCL = 700 ppb). Concentrations of these herbicides are generally very low, and some do no have MCL drinking water limits. Their presence in water used for drinking, recreation and other uses is nevertheless a concern.

Mission Lake Atrazine TMDL and Other Herbicides:

Mission Lake, located just northeast of the City of Horton, currently has a TMDL for the herbicide atrazine. Average concentrations of atrazine in Mission Lake are cited at 4.4 micrograms per liter based on 5 years of sampling data collected between 1989 to 1998 [KDHE, Kansas-Lower Republican Basin TMDL's, KDHE website]. Atrazine levels that exceed the drinking water MCL level of 3 ppb is one of the reasons why the lake is no longer used by the City of Horton as a drinking water source.

Mission Lake also had the highest recorded concentration of the herbicide acetochlor found in the state in 2002. The KDHE Lake Monitoring Program that year recorded an acetochlor concentration of 2.1 ppb [KDHE, Lake and Wetland Monitoring Program 2002 Annual Report, Oct. 2003]. A relatively new herbicide, acetochlor is used to control annual grasses and some broadleaf weeds in corn, soybeans and sorghum. There was no atrazine detected in Mission Lake in 2002, but a concentration of 1.6 ppb of Deethylatrazine (an atrazine degradation product) was found.

(5) Household and Farmstead Hazardous Waste (HHW)

According to KDHE, the average household in Kansas generates 15 pounds of hazardous chemical waste each year. A hazardous product has at least one of the following properties:

- ✓ Corrosive (eats through materials; acid for example)
- ✓ Reactive (can spontaneously ignite or create poisonous vapors when mixed with other chemicals)
- ✓ Flammable (burns easily)
- ✓ Toxic (poisonous or causes long-term illness)

Many products such as oven cleaners, paints, pesticides, auto fluids, batteries, pet shampoos, and a whole host of others used in everyday life are considered "hazardous" (see the website www.govlink.org/hazwaste/house/products/list.cfm for a more complete list). Since so many products are considered hazardous, it is very important that these materials be disposed of properly to protect human health and the environment.

The main environmental danger hazardous waste poses is a result of improper disposal or leaks/spills leading to water contamination. Frequently, hazardous chemicals are disposed of in regular household trash, endangering sanitation workers, winding up in landfills and threatening ground and surface water. Sometimes these chemicals are simply dumped on the ground, or are poured down storm drains. This is especially dangerous as storm drains provide a direct conduit to streams in the area. Volatile organic chemicals, heavy metals like mercury and lead, and a long list of other dangerous substances can find their way into water supplies as a result. Very often, hazardous chemicals are simply stored for years, accumulating in large quantities in basements, garages, under sinks, and in sheds until a property changes hands, a spill occurs, or something else happens to necessitate the disposal of a large volume of material.

Public education about what hazardous wastes are and how to deal with them properly is critical to protecting water quality in the Delaware watershed. Providing the means for proper disposal of these hazardous chemicals from homes and farms is equally as important. Household hazardous waste (HHW) disposal programs in the watershed are not adequate to provide the protection needed. Only three of the five counties in the watershed provide disposal hazardous chemical programs for their residents. Nemaha and Jefferson Counties have had successful programs for many years. Jackson County has a small program, but it needs to be upgraded to increase its effectiveness. Brown and Atchison Counties currently do not provide any type of HHW disposal program at all. Since HHW disposal can be expensive and is paid for by local county budgets, counties with HHW programs are reluctant to allow non-residents to use their facilities. For this reason, it is important that all counties in the region provide an HHW education and disposal program. This will require the commitment of additional resources each year by these counties.

(6) Water Wells

Groundwater is not an abundant resource in northeast Kansas. Nevertheless it is a very important one because it is the most widely used source of water for drinking in the area.

Portions of the Glacial Drift Aquifer can be found in northwestern parts of the Delaware watershed. This water is usually hard and often has high nitrate levels. Alluvial aquifers also exist throughout the region in close proximity to the rivers and streams of the watershed. These alluvial aquifers are the primary source of water for many of the public water supplies within the basin since they are capable of yielding large quantities of water. Outside of alluvial and glacial drift aquifers, groundwater in the Delaware basin is scarce.

There are 21 public water suppliers in the watershed, 20 of which use either only groundwater or groundwater and surface water together to supply their needs. The exception to this is the Kickapoo Nation near Horton. The Kickapoo Nation provides drinking water to residents within reservation boundaries using surface water exclusively (water for the Kickapoo Nation comes directly from the Delaware River). In addition, it is estimated that over 450 privately owned wells supply water to rural residents in the watershed. Because groundwater is such an important water supply for human consumption, the quality of this water must be very high in order to protect human health and to keep water treatment costs low.

Groundwater is better protected than surface water from outside contamination by the layers of soil and rock overlying it, but contamination of this resource does occur. Contamination of wells is often the result of citing wells in close proximity to pollution sources such as livestock lots, septic drain fields, or other pollutant sources. Pollutants present in streams, ponds and rivers can also enter shallow groundwater that is closely connected to surface water in alluvial aquifers. Groundwater contamination can also occur when contaminated runoff has direct access to an aquifer. This happens when runoff enters drill holes around poorly constructed wells or runs into well pits and abandoned wells. For this reason, proper well location, construction and plugging of pits and abandoned wells are important to the protection of groundwater in the region.

Public Groundwater Supplies:
The 1996 Amendments to the Safe Drinking Water Act required each state to develop a Source Water Assessment Program (SWAP) and develop a Source Water Assessment (SWA) for each public water supply that treats and distributes water from a raw source. The SWA identifies potential pollutant sources in proximity to water supply sources, and rates the potential for these sources to be impacted by pollutants. However, protection planning was not a requirement in the SWA's. These assessments can be used by individual public water suppliers on a voluntary basis as a means to develop their own individual protection programs to ensure that public water supply sources are well-protected. **Appendix E** lists the groundwater public water supplies regulated by KDHE, and the SWA susceptibility scores for each within the Delaware River watershed.

Public water suppliers have been encouraged to utilize the SWA data to develop source specific protection plans, but few have. To date, only 2 of the 21 public water supplies in the watershed have developed source water protection plans. This is in spite of resources available to aid public suppliers to develop these plans. The Kansas Rural Water Association (KRWA) has funding available to assist water suppliers in the state with development of Wellhead Protection Plans, and

can do so for little or no cost to the supplier. One of the obvious ways to provide protection to groundwater supplies in the Delaware watershed is to take advantage of SWA resources and wellhead protection program planning already available through the KRWA.

Private Wells:

Private wells are an important source of drinking water to the rural population in the Delaware basin. Although the exact number is unknown, it is estimated that at least 450 private wells are used for drinking water in the watershed. Educating the public about plugging abandoned wells, protecting private wells, proper well location and construction is important to protecting public health and groundwater. Several programs to accomplish this are available including the River Friendly Farms Environmental Assessment and Home*A*Syst through the Kansas Rural Center and the Cooperative Extension Service. Similar to an SWA, these are tools rural residents can use in evaluating their own homes and farms, locating any potential water contamination sources and helping determine best practices to do a better job of protecting the water resource. Several online resources available to livestock, farm and home owners to assist them in evaluating their property for pollution and health risks or to find technologies and techniques available to improve their property can be found on these websites:

www.oznet.ksu.edu/kles/ www.kansasruralcenter.org/CWFP.htm
www.sbeap.org/homeasyst/

(7) Point Sources

Great strides in water quality protection have been made since the passage of the Clean Water Act in 1972. This is especially true with respect to point source pollution reduction. More information about the history and purpose of the Clean Water Act can be found at the following web address: www.epa.gov/r5water/cws.htm. Point source pollution sources such as municipal and industrial wastewater treatment facilities are regulated and required to be permitted by the State of Kansas through the National Pollutant Discharge Elimination System (NPDES) established by the Clean Water Act (see text box on **page 24**). Presently, there are 43 permitted NPDES wastewater treatment facilities within the watershed. A permit for each wastewater facility requires pollution controls that must be implemented by the facility to protect water quality. These permits are reviewed every 5 years.

Because of this scrutiny, point sources are not considered to be large contributors to water quality problems in the Delaware basin. One notable exception to this may be wastewater treatment plants that have been unwilling or unable to meet pollution reduction levels prescribed by NPDES permits. Wastewater treatment facilities receive wastes from homes, storm drainage, small industry and other municipal sources. These wastes must be treated to remove harmful pollutants before the water is discharged to a stream or lake. However, the type and volume of waste generated and the population of cities change over time, making some wastewater treatment facilities less effective at removing pollutants as they age. New and more efficient technologies to treat waste have emerged, but the cost of upgrading facilities can be very high. Rural communities like those in the Delaware basin with small or dwindling populations often find the costs of upgrading wastewater facilities especially burdensome.

The Delaware watershed has many rural towns and cities with small populations. The two largest cities in the basin, Holton with a population of approximately 3,350 and Sabetha, with a population of approximately 2,500, completed major upgrades to their wastewater facilities in 2006. Costs for these upgrades alone were over $7 million. A number of smaller municipalities and sewer districts in the watershed are also in need of wastewater collection and treatment upgrades. Some of these collection system upgrades are to provide public sewage collection systems to replace individual on-site septic systems within a housing development, or to replace leaking collection lines and aging lagoons. All involve large costs that will be difficult for these small communities to absorb. A list of public wastewater treatment facilities in need of upgrades in the Delaware watershed is listed in **Table 9**.

Table 9: Delaware Watershed Public Wastewater Treatment Plant Needs, Cost and Status

Facility Name	Description of Upgrade Needed	Estimated Cost	Status
Everest WWTP	New collector and interceptor sewers; engineering study to address occasional high BOD discharges from lagoons	$143,000	No action at this time; engineering study needed
Horton WWTP	Advanced treatment improvement; nutrient removal and disinfection of effluent	$222,000 (immediate need) $1,700,000 by 2017	Schedule of compliance deadline Dec. 1, 2009
Lakeside Village Improvement District	New collector and interceptor sewers	$234,000	No action at this time
Wetmore WWTP	Existing old trickling filter system to be replaced with a new lagoon	$870,000	Low interest loan secured; application for CDBG grant made
Lakewood Hills Improvement District WWTP	Completion of second ½ of grinder pump/pressure sewer system (Phase II of ongoing project) and collection system	$1,695,000 (for Phase I & II)	Phase I (first ½ of grinder pump/pressure sewer system and new WWTP) completed
Jefferson Co. SD #6, Lake Shore Estates WWTP	Rehabilitation of collection sewers (existing collection system suffers from extreme leakage)	$488,000	No enforcement action at this time

Table 9 (continued): Delaware Watershed Public Wastewater Treatment Plant Needs, Cost and Status

Facility Name	Description of Upgrade Needed	Estimated Cost	Status
Jefferson Co. SD #7, Lake Ridge Estates WWTP	Rehabilitation of collection sewers (existing collection system suffers from extreme leakage) and lagoon improvements	$1,464,000	Loan application in process
Ozawkie WWTP	Expansion of lagoon system; current non-discharging lagoons occasionally fill to capacity, necessitating discharge	None available	No enforcement action at this time

Source: EPA, Clean Water Needs Survey
Data from KDHE Bureau of Waste Management
Data from City of Horton

PRIORITIZATION OF WATER ISSUES and RESOURCE USE

Resources necessary for addressing water issues include such things as funding to implement best management practices, technical assistance, community leadership, educational, informational and data resources. These resources are frequently in limited supply, and must be allocated in the most efficient manner possible to have the greatest impact. To do this, it becomes necessary to prioritize where resources will be used. This is not intended to diminish the importance of issues that may receive lower priority, but is a necessary step in making sure that the most pressing needs receive the greatest attention first.

The size of the Delaware River Watershed and the number of water issues in the basin required stakeholders involved in the development of a watershed restoration and protection strategy to make decisions as to where available resources will be focused. This prioritization process involved three phases. First, the seven major water issues were ranked according to their priority relative to each other. Next, priority areas and sub-watersheds within the larger watershed were identified, keeping in mind the highest priority issues identified in the first step. Finally, best management practices necessary to improve the water quality concerns identified were also prioritized within each issue.

STEP ONE: PRIORITIZATION OF THE SEVEN WATER ISSUES

A series of at least 12 public WRAPS meetings were held in 2006. Discussion and information sharing at these meetings resulted in the identification of seven major water quality issues of most pressing concern within the Delaware River watershed. In January 2007, stakeholders who had attended any of the public meetings in the previous year were invited to a special work session to refine the objectives and goals of the Delaware River WRAPS project. The group used a prioritization technique to assign priority ranking for each of the seven major water issues in the watershed. This was done using the Pairs Comparison Technique for Prioritization, which uses preference scores to prioritize a list of items. Information like that contained in **Table 10** was presented to the group. Each cell of this matrix represents a pairing of the seven major water issues. The stakeholders looked at each pair and selected the one that they perceived as most important of the two, or their "preferred choice". The choices were tallied and a ranking assigned to the issues in order of their priority.

Although the Pairs Comparison Technique is a simple method of prioritizing, it is not necessarily an easy one. Discussions about each pair in the matrix revealed the importance of each issue in the minds of stakeholders. There were some disagreements over the preference of one issue over another in a pairing. However, stakeholders who disagreed with a preference choice were given ample opportunity to state their case. The goal was to reach a level of consensus on priorities with which all the stakeholders could be comfortable. The exercise also illustrated how many of the seven issues are intricately related to one another.

The Pairs Comparison Technique often requires several rounds of comparisons, narrowing down priorities through a process of elimination. However, after just one round of choice preference selections and discussion, a priority ranking of the issues became evident. **Table 11** on the next page shows the ranking of the seven issues that resulted from this prioritization exercise.

Table 10: Pairs Comparison Technique for Prioritization

	Fecal Coliform Bacteria (FCB)	Household Hazardous Waste (HHW)	Nutrient Manage-ment	Pesticides/ Herbicides	Point Sources	Sedimenta-tion	Water Wells
Fecal Coliform Bacteria							
Household Hazardous Waste	FCB/ HHW						
Nutrient Management	FCB/ Nutrients	HHW/ Nutrients					
Pesticides/ Herbicides	FCB/ Pesticides	HHW/ Pesticides	Nutrients/ Pesticides				
Point Sources	FCB/Point Sources	HHW/ Point Sources	Nutrients/ Point Sources	Pesticides/ Point Sources			
Sedimentation	FCB/ Sediment	HHW/ Sediment	Nutrients/ Sediment	Pesticides/ Sediment	Point Sources/ Sediment		
Water Wells	FCB/Water Wells	HHW/Water Wells	Nutrients/ Water Well	Pesticides/ Water Wells	Point Sources/ Wells	Sediment/ Water Wells	

Table 11: Issue Preference Scores

Issue Ranking, in *Order of Priority*		Issue	Preference Score
1. Sedimentation		Fecal Coliform Bacteria	IV
2. Nutrient Management		Household Hazardous Waste	II
3. Fecal Coliform Bacteria		Nutrient Management	V
4. Pesticides/Herbicides		Pesticides/Herbicides	III
5. Household Hazardous Waste		Point Sources	0
6. Water Wells		Sedimentation	VI
7. Point Sources		Water Wells	I

STEP TWO: PRIORITIZATION OF SUB-WATERSHEDS

After the seven water issues were prioritized as described in Step 1, stakeholders examined modeling data for the watershed. Maps of watershed pollutant loads developed using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) model for the year 2005 were used. These maps illustrate expected pollutant loads at the Hydrologic Unit Code 14 level. Maps showing sediment, nitrogen, phosphorus and biological oxygen demand (BOD) loads were used. Copies of the maps can be found in **Appendix F.**

After examining the modeling data, stakeholders felt that resources to address water issues should be concentrated in the HUC 14 sub-watersheds where models showed the greatest pollutant loading for sediment, phosphorus and nitrogen. Generally speaking, these sub-watersheds can be found in the northeastern part of the watershed, with a few others scattered in the other areas of the Delaware basin. These areas will be given priority over other areas for resource expenditures to implement BMP's when those resources are not sufficient to meet needs basin-wide.

Hydrologic Unit Codes (HUC) are a hierarchal classification of hydrologic drainage basins in the United States. Each hydrologic unit, or watershed, in the U.S. is identified by a unique HUC designation consisting of a series of numbers. Very large watersheds such as the Missouri River watershed are identified by two-digit numbers. Larger watersheds are divided and sub-divided into successively smaller hydrologic units with successively longer numbers. The Delaware River watershed designation, HUC 10270103, is eight digits long. Within the Delaware River basin, there are multiple other smaller watersheds designated with up to 14 digits. These HUC 14's, as they are called, represent sub-watersheds of varying size within the Delaware basin.

Prioritization of sub-watersheds using modeling data can be problematic if data used to generate models is incomplete or incorrect. Weighing the information that models provide against real-world data is necessary to ensure that what a model tells us is indeed what really exists. In the case of the Delaware River watershed, available monitoring data does support the theory that sub-watersheds in eastern portions of the Delaware basin generally suffer from the heaviest pollutant loads. Much of this data has been discussed previously in this document.

STEP THREE: PRIORITIZATION OF BEST MANAGEMENT PRACTICES

Stakeholders also ranked the best management practices (BMP's) that had been developed to address each of the seven water quality issues identified in the Delaware River watershed. These BMP's are listed in the Goals and Objectives section of this document (beginning on **page 48**). The order in which the BMP's are listed on these charts indicates their relative priority ranking within that issue. Individual objectives within each issue are also listed in order of priority.

The prioritization of the BMP's in the Goals and Objectives section of this plan is not the result of an arbitrary ranking. A great deal of discussion, thought and information went into deciding which BMP's would be included in this plan as well as which ones would receive higher or lower priority. This ranking also reflects the ideas and input of many people and not one single individual. Stakeholders who had attended WRAPS meetings throughout the previous year gathered in January 2007 to focus on these prioritization issues. Most of the individuals who contributed to this process have been heavily involved in the development of the Delaware River WRAPS plan, and have expertise in water quality matters. The end result is a well thought-out order of priority based on the best information available for the watershed.

MONITORING, MODELING AND OTHER DATA NEEDS

It should be noted that current monitoring programs tend to concentrate on streams in the eastern half of the watershed, especially along the Little Delaware and main stem of the Delaware below the town of Muscotah. The map of KDHE monitoring sites in **Appendix G** illustrates this point clearly. These eastern areas are monitored more frequently and more densely than western areas of the watershed. Although other agencies also maintain some monitoring activities within the watershed, the KDHE stream and lake monitoring program is by far the largest.

Increased monitoring activity will be necessary in the Delaware River basin to more fully refine water quality conditions in the watershed, and to evaluate how well water quality improvement efforts are working. Future monitoring efforts should expand upon existing efforts rather than shifting sites from their current locations. This will require the addition of new monitoring sites, especially in the western sub-watersheds.

In addition, more refined modeling of pollutant loads in the watershed will be required. Modeling of the watershed using the Agricultural Non-Point Source Pollution (AGNPS) model is currently underway, and will be available to help prioritize activities during the implementation phase of the Watershed Restoration and Protection Strategy for the Delaware River. Additional monitoring data will be very useful for future modeling efforts. Periodic updates of model information will also be helpful as the models are improved, and comparisons can be made over time as BMP's are implemented.

Because sedimentation is such an important issue in the Delaware watershed and is inter-related with so many other water issues in the basin, a broad-based sediment source study is necessary. Identifying whether sediment is coming from eroding cropland, pastures and other surface locations, or whether it is coming from stream banks and lakeshore sloughing is necessary to making good decisions about where to use resources to reduce sedimentation. The 2007 USGS study of the Perry Lake and Lake Wabaunsee watersheds [Juracek and Ziegler, 2007] was the beginning of such an effort to identify specific sedimentation sources and should be expanded upon. In addition, periodic sediment and bathymetric surveys of Perry Lake on a regular basis will yield invaluable data on the sedimentation rates of the lake.

Continued monitoring of water quality conditions in area lakes is also critical. Because lakes receive and collect runoff from their surrounding watersheds, they are excellent barometers of watershed health and provide information about what activities in the basin are impacting water quality in the area. With this in mind, the U.S. Army Corps of Engineers monitoring activities at Perry Lake, and Kansas Dept. of Health and Environment Lake Monitoring programs should be continued and expanded. It is clear from recent monitoring data that threats to water quality are ever-changing. Monitoring and testing programs must keep pace. For example, atrazine has been a serious and persistent problem in the watershed for at least two decades. It appears that the threat of this chemical as a water contaminant, although not gone, is now lessening. However, other herbicides such as acetochlor and glyphosate are being used more and more as chemical usage and farming practices change. These new chemicals may present new water quality challenges for the future and must be monitored.

Prioritized Goals and Objectives for the Delaware River Watershed

The ultimate aim of this Watershed Restoration and Protection Strategy plan is to improve the water quality in the Delaware River basin. In order to achieve this, goals and objectives were developed to address each of the seven water quality issues that were identified by stakeholders. Best Management Practices (BMP's) to address each issue were incorporated into objectives related to the goals as well. For simplicity's sake, this information is presented here in charts for each individual water quality issue. **The charts are shown in order of priority, with the highest priority water issue (sedimentation) listed first, second highest priority issue (nutrient management) second, etc**. **Objectives within each issue and the best management practices designed to meet those objectives are also listed within each issue in the order of their priority relative to other objectives and BMP's in that issue.**

Costs for implementation of each BMP were estimated. These costs are broken out into long term costs and short term costs to aid in budgeting. Agencies or groups responsible for taking action or available to assist in implementation of BMP's are listed with each BMP. The lead agency(s) or organization(s) is in **bold type** for each.

FUNDING – Where will the dollars come from to fund this Strategy?

The implementation of the practices listed here will take the concerted effort of many individuals, agencies, organizations, local, state and federal government entities. It will also take a great deal of funding. Indeed, the biggest question that is asked, and that must be answered, is "where will all the money to fund the implementation of these practices come from?"

The specific answer to that question will be developed over the coming months and years as this plan is implemented. Cost share funding from state and federal agencies, in-kind matching funds, competitive grants, funds from local units of government such as cities, counties, watershed districts, rural water districts and others, and individual landowners' own funds will be necessary. Of course some BMP's do not involve costs at all, and those who implement some may even realize a financial benefit. But the hard work of finding funds and other resources and directing them to the most critical areas first, educating the public and adopting practices that will protect and restore the watershed is still ahead.

Listed below are a few of the funding sources that are expected to be used to implement the Delaware River Watershed Restoration and Protection Strategy. Exactly where all the resources will come from will become evident as implementation of the plan takes place over time.

State and Federal Agency funding and grant programs:

- SCC - Water Resources Cost-Share Program; Nonpoint Source Pollution Control Program; Riparian & Wetlands Protection Program
- FSA and NRCS – Multiple programs including Conservation Reserve, Source Water Protection, Farmable Wetlands, Grassland Reserve Programs
- EPA – Multiple grant programs available directly to watershed restoration activities or through the Kansas Dept. of Health & Environment including Section 319 Nonpoint Source Pollution Control Grants
- USFWS, KWO, KDHE, and others

Private funding and grants from wildlife and outdoors organizations (for example, Kansas Alliance for Wetlands & Streams, Pheasants Forever, Ducks Unlimited, Cabelas' Bass Pro Shop, etc.), private foundations and other organizations

Individuals as new habits and actions are adopted, as a supplement to cost share, and as individuals take action on a voluntary basis

Sedimentation, stream bank erosion and water quantity

***GOAL 1*: Reduce sedimentation and stream bank erosion to extend the usable life of Perry Lake and other watershed lakes for public water supply, recreation, flood control, and aquatic life support.**

***GOAL 2*: Reduce sedimentation to decrease the amount of sediment-attached pollutants that are delivered to streams, Perry Lake and other watershed lakes.**

ISSUE: **Perry Lake** average annual sediment yield from the watershed has been estimated at 2,400,000 lbs./square mile. Estimates show as much as 23% of the lake's sediment storage capacity is already filled. **Mission Lake** has at least 74% of its storage filled with sediment. Implementation of soil conservation practices in northeast Kansas has accelerated greatly since the 1980's. Most of the Mission Lake watershed is fully treated with structural erosion control measures. Emphasis has been placed on controlling erosion to tolerable soil loss levels ("T"), but offsite impacts of eroded soil, even if the amount is below "T", may be detrimental to water quality and significant enough to impair water uses . Many watershed dams have been constructed within the Delaware basin, but the level of funding for additional watershed structures has been significantly reduced. Dams act as sediment traps, resulting in less sediment being delivered to larger lakes in the watershed. However, removal of silt from streams by dams may contribute to downstream bank scouring ("hungry water").

TARGET: Decrease rate of actual sedimentation into Perry Lake by 50% by 2017. Secure federal funding to conduct updated sedimentation deposition estimate survey during 2012 and 2017.

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Objective #1: Reduce erosion and sediment loading to streams through use of riparian buffer strips and stabilization of stream banks.						
Riparian Buffer strips (with grazing allowances)	Install more buffer strips that are designed to work at max efficiency; target high priority areas	Landowners with streams, wetlands or ponds on property; absentee landowners; tenants	*3,000 acres *10 years *$2 million	300 ac/year (approx. $200,000 /year)	Flat rate: $700/ac (native), $400/ac (cool season), $1,000/ac (Trees); $500/ stream crossing [one time payment maintained 10 years]	**Cons. Districts**; **NRCS**; Extension; SCC; KRC; KS Forest Service; KDWP; USFWS; KAWS; KDHE; Watershed Districts; FSA; NEKES

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Grading and structures to enhance buffer strip effectiveness	Cost share on grading to ensure sheet flow over buffer strips, structures to enhance infiltration of runoff and stabilize grades, etc	Crop and livestock producers and landowners	*50 projects *10 years *$125,000	5 projects/year	$2500 / project	**Cons. Districts**; **NRCS**; **SCC**; Extension; KRC; KS Forest Service; KDWP; USFWS; KAWS; KDHE; Watershed Districts; FSA; NEKES
Buffer strips in pastures and rangeland	Cost share for fencing riparian buffer areas or other buffer improvements along streams in pastures; easements on strips; focus on priority areas	Livestock owners; all landowners including absentee	*1,000 acres buffer strips in pasture and rangeland *10 years *$500,000 (another $500,00 for fence)	100 acres/year (approx. $50,000/year for easements, $50,000 for fence)	$1.40/foot for fence; one-time payment of $500/ acre for easement	**Cons. Districts**; **NRCS**; **SCC**; Extension; Livestock Associations; KDWP; USFWS; KS Forest Service; KAWS; KRC; Watershed Districts; FSA; KFB; NEKES
Stream bank stabilization	Educational workshops & cost share on stream bank stabilization projects in high priority areas	All landowners with streams on their property including absentee	*5 workshops *50 stabilization projects *10 years $1,010,000	*$1000/year for workshops *5 projects/year (approx. $100,000/year)	$1,000 per workshop $20,000 per project	**KAWS**; Extension; Cons. Districts; NRCS; KS Forest Service; KDWP; USFWS; Corps of Engineers; SCC; NEKES; Watershed Districts
Relocate water, feeding, shelter for livestock out of riparian areas	Education; cost share on alternative water sources and other practices to move livestock out of riparian areas; focus on priority areas	Livestock owners, all landowners including absentee	See FCB and Nutrient Mgt. practices	See FCB and Nutrient Mgt. practices	See FCB and Nutrient Mgt. practices	**Extension**; Cons. District; NRCS; KDWP; KS Forest Service; KAWS; Watershed Districts; NEKES; KRC

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Stabilized stream crossings and watering sites for livestock	Cost share on stabilized stream crossing or watering sites for livestock; focus on priority areas	Livestock owners, all landowners including absentee	*125 projects *5 years *$325,000	25 projects per year (approx. $65,000/year)	70% cost share; $500 for stream crossings Up to $5,000 for livestock watering	**Cons. Districts**; **SCC**; **NRCS**; Livestock associations; Extension; Watershed Districts; KAWS; NEKES; KRC
Stabilize stream banks and bare area during road and bridge construction, and land development projects	Education; letter to city or county road and bridge departments, work with KDOT, counties and developers	KDOT, City or County road and bridge departments; developers; Realtors; Homeowner Associations	All current and future road, bridge and development projects using stabilization practices	2008 and annually thereafter	N/A	**KDOT; County Road & Bridge Depts**.; Land developers and construction contractors; Realtors; Homeowner Assoc. ; NEKES
Encourage cities and counties to adopt ordinances requiring buffers along streams and around wetlands and lakes	TA and Letters to cities and counties to inform them of WRAPS goals and KS Urban Water Quality Protection Initiative at K-State	Cities and Counties	Buffer ordinances in cities and counties in watershed by 2017	2008 and annually thereafter	N/A	**K-State Extension**; Kansas Forest Service; KBS; Cities; Counties; City and County Associations; NEKES
Objective #2: Reduce erosion from cropland by implementing soil-saving cultural practices that reduce sedimentation.						
Improve soil tilth, go beyond "T" and manage for "C" (soil organic matter or soil carbon) [See Note 1 below]	Cost share on cover crops, no-till, legume rotations, use of manures, etc. to increase "C"levels; encourage use of no-till on land converted from CRP	Crop producers; all landowners including absentee	*25,000 acres/year in soil tilth improvement practices (target priority areas) *10 years *$300,000	2,500 ac/year (approx. $30,000/year)	$12/acre average	**Extension**; Cons. Districts; NRCS; SCC; KDA; EPA; KRC; KDHE; No-Till on the Plains; KFB

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Objective #3: Reduce erosion from pasture and rangeland.						
Grazing Management Plans	Incentive payments for pasture and range mgt. plans; focus on priority areas	Livestock owners, all landowners including absentee	*160,000 acres in stocking rate/proper grazing use implementation *10 years *$800,000	16,000 ac/year (approx. $80,000/year)	$5/ac/yr (max. of 320 ac per landowner, one-time payment)	**Cons. District; SCC; NRCS; Extension**; Livestock associations; Watershed Districts; KFB; KRC
Objective #4: Reduce erosion by converting cropland to permanent vegetative cover, and reducing the amount of land that is converted from permanent cover to cropland use.						
Convert cropland to grass and/or trees	CRP buffer strip and other grass and tree-planting programs; Permanent easements if possible; reduce taxes on converted acres [See Note 2 below]	Crop producers; all landowners including absentee	*5000 acres planted to trees or grass *10 years *$3 million	500 ac/year (approx. $300,000/year)	$600/ac (cool season grass), $700/ac (native grass), $1000/ac (trees) [See Note 2 below on reducing taxes]	**Extension; NRCS; Cons. Districts; KS Forest Service**; KRC; KDWP; USFWS KAWS; Wildlife organizations; FSA; County Appraisers; Watershed Districts
Keep erodible areas in grass and tree cover	Keep land in grass or tree cover using non-traditional $ sources (Cabela's, Bass Pro, Carbon credits, etc.), encouraging fee hunting, and other incentives; extension of CRP payments, CSP	Crop producers; all landowners including absentee	Maintain 80% of CRP acres in grass or tree cover as it comes out from under USDA contract TBD	Start 2008 (costs TBD)	Incentive payments of $50/acre to keep land in permanent grass or tree cover after CRP contract ends	**Extension;** NRCS; Cons. Districts; KDWP; USFWS; KS Forest Service; KRC; KAWS; Wildlife/conservation organizations; FSA

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Stabilize terrace channels	Plant terrace channels to grass	Crop land owners and renters	*500 acres of terrace channels *10 years *$300,000	50 ac/year practices maintained for min. 10 years (approx. $30,000/year	$600/ac (cool season grass), $700/ac (native grass) [one time payment maintained 10 years]	**NRCS; Cons. Districts; SCC**; Extension; KS Forest Service; KRC; KDWP; USFWS KAWS; FSA; NEKES
Objective #5: Utilize grade stabilization structures and watershed projects to reduce erosion.						
Mitigation of watershed dam construction areas	Funding for mitigation practices; maintenance of mitigation practices for easement period	All landowners including absentee; Watershed Districts	Assist with the cost of mitigation	TBD Based on approval of Watershed Dam projects	TBD Based on mitigation needs of individual dam projects	**Watershed Districts**; NRCS; Cons. Districts; SCC; KDWP; Corps of Engineers
Grade stabilization structures	Cost share on sediment control basins, diversions, settling basins and other grade stab. structures, especially at field edges and other critical areas	Crop and livestock producers and landowners	*50 grade stabilization structures *10 years *$250,000	5 grade stabilization structures/year (approx. $25,000/year)	$5000/grade stabilization project	**Watershed Districts**; **NRCS; Cons. Districts; SCC**; KDWP; Corps of Engineers
Objective #6: Secure federal funding for sedimentation survey of Perry Lake in 2012 and 2017.						
Sedimentation survey	Letter of support for KBS and USGS to encourage lake sedimentation survey to track progress	USGS/KBS	*Two surveys in next 10 years *$100,000	Done in years 2012 and 2017	$50,000 per survey	**USGS**; USACE; KGS; USDA; KBS

NOTE 1: **"T" = "Tolerable Soil Loss".** This is the soil loss rate that equals the soil formation rate expressed as tons per acre per year (tons/ac/year). Most soils in northeast Kansas have a "T" value of 4 or 5 tons/ac/year. There is much debate as to the validity of "T" values, as some studies suggest that soil formation rates are much slower than originally thought. Average soil formation rates that range from 0.01 to 0.8 tons/ac/year have been shown in some areas [Alexander, E.B. 1988. Rates of Soil Formation: Implications for Soil-loss Tolerance. Soil Science 145: 37-45]. The impact of eroded soil, even if erosion levels are controlled to "tolerable" levels of less than 4 or 5 tons, may still be detrimental to water quality. Offsite impacts may be significant enough that water bodies are unable to support designated uses.

"C" = Carbon levels in soil, or soil organic matter. Carbon in soil is the living and formerly living matter that makes soil "spongy", friable and more productive. A "C" level of about 5% is considered good and is what one would expect to find in untilled, native prairie soils. Most modern farming practices, with the exception of no-till, tend to deplete "C" levels. Organic matter in soils enhances water and nutrient holding capacity, improves soil structure, reduces runoff, and increases soil productivity, all characteristics that protect water and environmental quality. Increasing "C" levels in soils also helps to decrease atmospheric carbon dioxide levels by sequestering carbon from the air into the soil profile. Managing for "C" focuses on enhancing the soil's condition as opposed to managing the soil for tolerable degradation, which is what "T" focuses on. Most practices that manage for "C" are cultural practices (for example: planting cover crops, crop rotations, reducing tillage and practicing rotational grazing). Although cultural practices are also useful for reducing erosion to tolerable levels, the focus of managing for "T" tends to be on structural erosion controls such as terraces and waterways.

NOTE 2: County Appraisers will reduce property valuations on land enrolled in the USDA Buffer Strip program substantially, but this must be at the request of a landowner and verified by USDA. Property valuations can also be reduced significantly for land that was enrolled in the CRP program after the CRP contract has expired, but again the landowner must initiate the reduction in valuation with the Appraiser's Office in their county.

Nutrient Management
(Especially non-point sources of Phosphorus)

***GOAL*: *Reduce nutrient loading (especially Phosphorus) of streams and lakes within the watershed from non-point sources to limit algae blooms and improve aquatic life support in streams and lakes in the watershed; reduce Phosphorus levels in Mission Lake to meet TMDL Eutrophication endpoints*.**

ISSUE: The Delaware River contributes 9% of the average flows of the Kansas River. Current average Phosphorus levels in the watershed are 0.27 mg/l, 1.44 mg/l for nitrogen. Levels of phosphorus >0.05 mg/l, or of nitrogen >1 mg/l indicate eutrophic conditions. Phosphorus and nitrogen often exceed these levels in lakes and ponds in the watershed. Nitrogen to Phosphorus ratios in **Perry Lake** are frequently less than 10:1 which indicates a highly eutrophic (nutrient-rich) system that is conducive to algae blooms. Major sources of high levels of nutrients are fertilizer runoff, livestock and human wastes. **Mission Lake** has consistently elevated chlorophyll *a* concentrations and algae blooms during the summer months, averaging 21.1 ppb (related to Trophic State Index of 60.5, indicating very eutrophic conditions). Phosphorus levels in the lake are also consistently high. Due to the lake's shallow depth, re-suspension of sediment and nutrients is a likely contributor to turbidity and high chlorophyll *a* levels in the water. Designated uses for the lake include domestic water supply, primary contact recreation, food procurement, industrial water supply and aquatic life support. All uses are impaired by eutrophication and algae blooms in the lake. There are no known point sources in the Mission Lake watershed. Land use in the lake drainage area is primarily cropland (77%) and slow permeability in basin soils creates a strong propensity for runoff. There are Low Priority TMDL's for Eutrophication for **Little Lake** (small impoundment directly below Mission Lake) and **Sabetha Watershed Pond** (impoundment south of City of Sabetha which received effluent from the Sabetha WWTP up until February of 2006). Other water bodies may need to be addressed with TMDL's in the future. Emphasis should be placed on preventative measures to avoid future water quality problems

TARGET: The EPA set a goal of <0.10mg/l phosphorus to protect aquatic life in streams. Reduce nutrients within the watershed to allow removal of **Perry Lake** from Kansas 303(d) list. The 303(d) list refers to Section 303(d) of the Clean Water Act which requires states to identify and list all water bodies in which state water quality standards are not being met. The Kansas Water Plan has established a goal to reduce the amount of nutrients (N and P) discharged from the State via the Kansas River by 30%.

Mission Lake: The TMDL for Eutrophication is a High Priority requiring 90% reduction of phosphorus loading to achieve full support of designated lake uses.

BMP or Method to achieve Goal	Actions necessary to implement BMP's	Target audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or responsible groups and agencies
Objective #1: Reduce the Phosphorus levels in Perry Lake to an average of 0.15 mg/l by 2017; this reduction Phosphorus levels should result in greater Nitrogen to Phosphorus ratios (> 10:1), lower frequency of algal blooms, improve aquatic life support, and contribute to the desired overall reduction in Phosphorus discharge in the Kansas River.						

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Control runoff from small livestock operations	Provide assistance to small livestock operations to control runoff using diversions, filter strips, constructed wetlands and other practices	Small livestock producers	*100 runoff controls installed on small livestock operations *10 years *$500,000	10 projects/year (approx. $50,000/year)	70 % cost share, $5,000 per operation (maximum)	**Extension; Cons. Districts; SCC; NRCS**; KAWS; KRC; KS Forest Service; KDWP; USFWS; Livestock Associations; NEKES
Buffer strips	Reduce penalties for grazing buffer strip to increase buffer strip installation	Crop producers; livestock producers; landowners with streams/lakes	See Buffer Strip practices under Sedimentation Issue	See Buffer Strip practices under Sedimentation Issue	See Buffer Strip practices under Sedimentation Issue	**Cons. Districts; SCC; NRCS**; Extension; KRC; KS Forest Service; KDWP; USFWS; KAWS; KDHE; Watershed Districts; NEKES
Buffer Strip Coordinator	Conservation Districts employ a Buffer Coordinator	Conservation Districts; SCC; NRCS	Buffer Coordinator(s) to serve all 5 Cons. District offices in the watershed	5 Coordinators, average approx. $80,000/year	$10,000 - $22,000 /year per Coordinator	**Cons. Districts; SCC**; NRCS; KWO; Extension; Watershed Districts; NEKES
Reduce fertilizer used on urban lawns, golf courses and other urban areas	Encourage soil testing to reduce fertilizer application rates on lawns and golf courses, application according to soil needs; better fertilizer timing; encourage “Backyard Conservation” methods in residential settings	Golf course owners; lawn care professionals; homeowners; municipalities	All golf course owners/managers and lawn care professionals contacted each year; 50% of urban homeowners owners contacted each year	Yearly to 2017	N/A Will produce a savings to individuals and businesses with reduced inputs	**Extension; Lawn care organizations; Golf course owners**; Cons. Districts; NRCS; SCC; KS Forest Service; KACEE; Golf Course Supt. Ass’n of America; NEKES

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Nutrient management plans	Soil testing, manure testing, adjusting timing, placement and application rates of fertilizers; utilizing manure as a fertilizer	Crop producers; livestock producers; fertilizer dealers & custom applicators	*250 comprehensive nutrient management plans *10 years *$125,000	25 Comprehensive Nutrient Mgt. Plans (CNMP) per year (approx. $12,500 /year)	Incentive payment of $500 to develop CNMP; soil test and sub-surface manure appl. incentive of $1,000	**Cons. Districts; NRCS; SCC**; Extension; KRC; Livestock associations; Crop prod. organizations; KDA; KDHE; NEKES
Keep livestock out of streams and ponds	Provide assistance to move lots, water source, feeding sites, calving and sheltering sites out of riparian areas, install "hard" stream crossings	Small livestock producers (un-regulated by state)	*100 livestock operations *10 years *$500,000	10 livestock operations/year (approx. $50,000/year)	$5,000 per operation	**Cons. Districts; SCC; NRCS**; Extension; KRC; KAWS; KS Forest Service; KDWP; USFWS; Watershed Districts; Livestock Associations; NEKES
Increase soil tilth of cropland in the watershed	*Long-term legume rotations *Use of cover crops *Use animal manures as nutrient source *Encourage no-till and reduced tillage *Convert cropland to grass or trees	Producers not already enrolled in CSP or EQIP	*50,000 acres in tilth improvement practices *10 years *$400,000	500 acres/year (approx. $40,000/year)	*Legume rot. $22/ac *Cover crop $30/ac *Manure use $8/ac (max $1000/farm) *No-till $10/ac *Planting of: cool season grass($63/ac) native ($72/ac) trees ($200/ac)	**Extension; Cons. Districts; NRCS; SCC**; No-Till on the Plains; KRC; KS Forest Service; Crop producer organizations; KDA; KDHE; NEKES
Composting of livestock wastes	Encourage proper, well-sited composting of livestock waste; TA and cost share	Livestock producers	See Composting of livestock waste under FCB Issue	See Composting of livestock waste under FCB Issue	See Composting of livestock waste under FCB Issue	**Extension;** Cons. Districts; SCC; NRCS; KAWS: KACEE; KRC; Glacial Hills RC&D; Livestock Associations

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Nutrient level monitoring to track goal target success	Send letters of support to US Army Corps of Engineers and KDHE supporting continued monitoring efforts	USACE; KDHE	Annual reporting data shows decrease in mean concentration of pesticides	2017	N/A	**USACE**; KDHE
Objective #2: Improve water quality in Mission Lake so that chlorophyll *a* concentrations are 12 ppb or less (relates to a Trophic State Index of <55, slightly eutrophic) to achieve full support of the lake's designated uses.						
Dredge Mission Lake	Assist City of Horton to obtain finances to dredge Mission Lake	City of Horton; SCC; KWO	Mission Lake depth increased sufficiently to assure improved water quality	2010	$6.6 million	**City of Horton; SCC**; Cons. District; NRCS; EPA; KDHE; Watershed District; NEKES
Note: The Mission Lake watershed is essentially fully treated in regards to reducing soil erosion rates to tolerable levels ("T" – see note on **page 54**). Additional land treatment and cultural management practices to reduce gully and stream bank erosion, improve soil tilth and reduce nutrient inputs to the lake are expected to be implemented if and when Mission Lake is dredged. The City of Horton has undertaken an extensive ground survey of the watershed to identify any problems that would need to be addressed, and has begun meeting with the landowners in the drainage to enlist their cooperation in implementing further erosion controls and nutrient management practices.						

Fecal Coliform Bacteria

Pasture management, animal wastes, on-site wastewater systems

GOAL*: *Reduce Fecal Coliform Bacteria (FCB) contamination so that streams and lakes in the watershed meet their designated use criteria; meet FCB Total Maximum Daily Load (TMDL) endpoints for Grasshopper Creek, and for the Delaware River and tributaries.

ISSUE: 92% of the impaired streams in the Delaware Watershed are impaired by fecal coliform bacteria. Sources may be livestock wastes, failing on-site wastewater systems, wildlife and occasional public wastewater system overflows.

***TARGET*: (1) Grasshopper Creek (HUC 11:10270103020) TMDL endpoints** = <10% S samples exceed secondary contact recreation (SCR) criterion @ flows < 80 cfs, none @ <15 cfs; <10% S-F samples exceed SCR criterion @ flows < 80 cfs, none @ < 10cfs; <10% W samples exceed SCR criterion @ flows <80 cfs (all by 2008). There are two NPDES permitted wastewater dischargers in the Grasshopper Creek watershed (Cities of Everest and Horton), at least 13 registered, certified or permitted livestock facilities (up to 3,786 animal units) and many smaller, unregulated livestock operations and rural homes in this 95 square mile sub-watershed. Land use is primarily agricultural (65% cropland, 31% grassland); grazing density is moderate (37 animal units/sq. mile). Based on assessment of sources, distribution of excursions from water quality standards and relationship to runoff, non-point sources are most likely the primary cause of FCB water quality violations. This is a High Priority TMDL recommending focus on Stream Segments 18 and 20 on Grasshopper Creek, 40 on Mission Creek and 41 on Otter Creek

(2) Delaware and Tributaries above Perry Lake (HUC 11's: 010, 030, 040, 050, 050 & 060) TMDL endpoints = <10% S samples exceed primary contact recreation (PCR) criterion @ flows <300 cfs, none @<75 cfs; <10% S-F exceed PCR criterion @ <300 cfs, none @ <40 cfs; <10% W exceed SCR criterion @ <300 cfs (all by 2008). There are 11 NPDES permitted wastewater dischargers within this sub-watershed (Cities of Goff, Huron, Holton, Muscotah, Netawaka, Powhattan, Sabetha, Wetmore and Whiting, and the Brown Co. KDOT rest area on Cedar Creek). There are at least 50 registered, certified or permitted livestock facilities in the sub-watershed as well (up to 10,393 animal units), most of which have waste control systems in place. There are many small, unregulated livestock operations and rural homes in this 679.5 square mile sub-watershed. Land use is primarily agricultural, with approximately 50% grassland and 43% cropland. Grazing density is moderate to heavy (43-52 animal units/sq. mile). Based on assessment of sources, distribution of excursions from water quality standards and relationship to runoff, non-point sources are most likely the primary cause of FCB water quality violations. This is a High Priority TMDL, recommending focus on western sub-watersheds (HUC 11's 010, 040 and 050)

* Secondary Contact Recreation Criterion (fishing, wading and other recreation with incidental water ingestion possible) = 2,000 FCB colonies per 100 ml of water
* Primary Contact Recreation Criterion (swimming) = 900 FCB colonies per 100 ml of water
* FCB = Fecal Coliform Bacteria; S = Spring, S-F = Summer and Fall, W = Winter; TA = Technical Assistance; TMDL = Total Maximum Daily Load

BMP or Method to achieve Goal	Actions necessary to implement BMP	Target audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or responsible agencies and groups
Objective #1: Reduce FCB contamination from unregistered or out-of-compliance livestock operations.						
Move livestock out of riparian areas	TA and cost share to provide alt. water sites, shelter, feeding or calving area, exclusion fence, fence for livestock distribution, and moving lots	Small livestock operations	*50 livestock operations *5 years *$250,000	10 livestock operations/year (approx. $50,000/year)	70% cost share, not to exceed $5,000 per operation	**Extension Cons. Districts; NRCS; SCC**; KRC; Livestock Associations; KAWS; KDWP; USFWS; KS Forest Service; Watershed Districts; NEKES
Control runoff from livestock operations	TA and cost share to install runoff and waste controls (filter strips, diversions, impoundments, etc)	Small livestock operations	See Livestock Runoff Controls under Sedimentation Issue	See Livestock Runoff Controls under Sedimentation Issue	See Livestock Runoff Controls under Sedimentation Issue	**Cons. Districts; NRCS; SCC; Extension**; KRC; Livestock Ass'n; KAWS; NEKES; KS Forest Service; KDWP; USFWS
Graze-able buffer strips	Continue buffer strip programs, and remove barriers to install more buffer strips	Landowners with land along streams and lakes	See Buffer Strip practices under Sedimentation Issue	See Buffer Strip practices under Sedimentation Issue	See Buffer Strip practices under Sedimentation Issue	**Cons. District; NRCS; SCC; FSA;** Extension; Livestock Associations: KRC; KAWS; KDWP; USFWS; KS Forest Service; Watershed Districts; NEKES
Grazing system management plans	TA and cost share for pasture management plans and implementation of practices	Livestock operations	*250 pasture mngt. plans *5 years *$62,500 *Goal of 100,000 acres for watershed	50 pasture management plans/year (approx. $12,500/year)	Incentive payment of $250 to develop a plan - must meet NRCS specs	**Cons. District; NRCS; SCC; Extension**; Livestock Associations; KRC; KAWS; Watershed District; NEKES

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Proper use of manures as fertilizer	Manure testing and soil testing with application according to recommendations; manure management plans and cost share	Livestock operations	*125 manure management plans *5 years *$100,000	25 manure mgt. plans (approx. $20,000/year)	Incentive pymt. of $500 to develop Comp. Nutrient Mgt. Plan (CNMP) w/ manure test; Incentive pymt. of $1000 for soil test/sub-surface manure placement	**Cons. District; NRCS; SCC; Extension**; Livestock associations; KRC; KAWS; NEKES
Extended grazing of forages	Planting annual or perennial forages to reduce time livestock spend in confined lots	Livestock operations	*125 extended grazing plans *5 years *$100,000	25 extended grazing systems per year (approx. $20,000/year)	Incentive payment not to exceed $500 for annual forage, $750 for cool season perennial, $1000 for warm season perennial	**Extension Cons. District; NRCS; SCC**; Livestock Associations: KRC; KAWS; KDWP; USFWS; KS Forest Service;
Proper disposal of dead livestock	Rebates for rendering of dead animals to prevent dumping of dead animals in creeks an ditches	Small livestock operations	*Proper disposal of all dead livestock *5 years *$12,500	Approx. $2,500 per year	$30 for horses and cattle, $15 for swine	**Cons. Districts; SCC**; NRCS; Extension; Livestock Association; Rendering companies; KDHE; NEKES
Objective #2: Improve on-site wastewater disposal methods to reduce the levels of bacterial contamination of surface water in the watershed.						
Locate failing on-site wastewater systems in the watershed	Inventory and locate failing systems in the watershed ("SERVE" project by NEKES, see note below)	Rural home owners or residents not on public sewer systems	*Locate failing on-site systems *3 years *$75,000	Start 2008	$25,000 per year	**NEKES; JF Co. Health Dept**.; SCC; Extension; Cons. Districts; KRC; KDHE; KAWS;EPA

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Repair failing on-site wastewater disposal systems	Cost share to replace or repair failing on-site systems (follow SCC on-site wastewater program guidelines); Enforce sanitary codes	On-site wastewater system owners	*1,000 systems repaired *10 years *$3,750,000	100 systems per year (approx. $375,000/year)	$3000 - $4500 per system (number of failing systems that meet SCC guideline is unknown)	**NEKES; JF Co. Health Dept.; SCC; Cons. District;** Extension; NRCS; KRC; KAWS
Maintenance of on-site wastewater systems	One-time rebate for septic system pump-out and installation of lid w/ access port on systems without access	Rural home owners or residents not on public sewer system	*1,000 systems maintained *10 years $250,000	100 systems maintained and improved /year (approx. $25,000/year)	$300 maximum per system (number of systems w/out access unknown)	**NEKES; JF Co. Health Dept.; SCC**; Cons. District; KDHE; Extension; NRCS; KRC; KAWS

Note: "SERVE" is an action program that addresses water quality issues identified by stakeholders in the watershed. It is a program proposed by NEKES to educate and motivate residents of the watershed community. It has five components: Service to the watershed community; Education of individuals about ways to protect water after evaluating existing water quality issues on individual properties; Referral of any water quality issues identified to appropriate and knowledgeable agencies and individuals; Verification that the service and education provided to an individual has produced the successful application of best management practices; and Enforcement of applicable federal, state and local laws by appropriate agencies.

Action is the key to this program, and the strength of SERVE is encouragement of individual property owners to define water quality issues that exist on his/her own property using existing "Farm/Home A-Syst" worksheets. This opportunity would be provided by NEKES during the 2,000 routine requested contacts and/or referrals the agency makes each year. An aggressive volunteer recruitment process will also employ the help of volunteers to help make contacts of both rural and urban watershed residents. This program will use stakeholder enthusiasm, WRAPS and other water quality efforts to inform, educate and motivate residents of the watershed community to take action that will protect and improve water quality through individual action and choices.

Pesticides in the Delaware River Watershed

***GOAL*: Reduce herbicide and pesticide contamination of water in the watershed; meet Atrazine TMDL endpoint for Mission Lake in Brown County.**

***ISSUE*:** Detections of pesticides, especially atrazine, in surface water in the Delaware watershed are common. The average atrazine concentration in the watershed is 1.64 ppb (exceeds the statewide average of 1.12 ppb). The nation's first Pesticide Management Area (PMA) was established for the Delaware watershed in 1992 and is still in force. Subsequent voluntary action and pesticide use restrictions appear to have been effective in reducing atrazine levels in watershed streams and Perry Lake. However, atrazine and atrazine degradation products continue to be detected. Atrazine frequently shows "spikes" in concentration following rainfall events during the growing season.

Historic data for **Perry Lake** (1996-2004) show median atrazine concentrations < 3ppb with occasional seasonal spikes > 3ppb. Perry Lake is the only U.S. Army Corps of Engineers lake in the Kansas City district to have exceeded the alachlor MCL of 2 ppb (in 2000). Other pesticides detected in surface water include acetochlor, metolachor, glyphosate and others.

Mission Lake TMDL: This TMDL is a High Priority, and was established based on average atrazine levels of 4.4 ppb from 5 surveys of the lake between 1989 and 1998. Mission Lake is no longer a drinking water supply for the City of Horton due to atrazine contamination as well as other quality and quantity problems with the lake. The 2002 monitoring data for Mission Lake showed no atrazine detected, but 1.6 ppb of Deethylatrazine (an atrazine degradation product), 0.29 ppb metolachlor and 2.1 ppb acetochlor were detected. This level of acetochlor was the highest level of that chemical detected in water in the state of Kansas in 2002. Primary land use in the lake's drainage is agricultural (77%) with approximately half the cropland planted to corn and/or sorghum and half to soybeans. Soils have slow permeability and a high propensity for runoff, characteristics that contribute to atrazine contamination potential.

TARGET: A Maximum Contaminant Level (MCL) for drinking water was established for atrazine at 3 ppb. This is also the recommended maximum level in water to protect aquatic life. **Mission Lake Atrazine TMDL** = only one excursion > 3ppb MCL level within a three-year period over 2004-2008. To achieve this endpoint, it is estimated that a load reduction of 25% is needed annually, allowing 3.5 pounds of atrazine to be retained by the lake.

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Objective #1: Continue to reduce average concentrations of atrazine in the watershed to statewide average levels or less, with only one excursion > 3 ppb within a 4-year period in Mission Lake to meet TMDL target. Continue to reduce concentrations of other agricultural pesticide contaminants within the watershed.						
Buffer strips	Increased number of buffer strips in cropland and pastureland	Landowners with land along streams or lakes	See Buffer Strip practices under Sedimentation Issue	See Buffer Strip practices under Sedimentation Issue	See Buffer Strip practices under Sedimentation Issue	**Cons. Districts**; **NRCS**; Extension; SCC; KRC; KS Forest Svc; KDWP; FSA; NEKES; USFWS; KAWS; KDHE; Wtsh District;

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Pesticide Management Area practices	Use the "12 Best Management Practices for atrazine" recommendations including setbacks; Education	Crop producers; Chemical dealers; Custom pesticide applicators; County weed departments;	Average atrazine levels in watershed <1.12 ppb; reduced levels of other pesticides	2010	N/A (these practices can reduce costs to producers)	**Extension; KDA**; Pesticide dealers/manufacturers; Co-ops and other custom pesticide applicators; Crop producer organizations; Cons. Districts, NRCS; County weed departments; KRC; NEKES
Integrated Pesticide Management	Education and utilization of IPM methods	Crop producers; Chemical dealers; Pesticide applicators; County weed departments;	Average atrazine levels in watershed <1.12 ppb; reduced levels of other pesticides	2010	N/A(these practices can reduce costs to producers)	**Extension; KDA**; Pesticide dealers/manufacturers; Co-ops and other custom pesticide applicators; Crop producer organizations; Cons. Districts, NRCS; County weed departments;
Improve soil tilth	Long-term legume rotations, no-till, cover crops, use of manures and other practices to increase soil organic matter levels	Crop producers	See Nutrient Management Soil Tilth Improvement practices	See Nutrient Management Soil Tilth Improvement practices	See Nutrient Management Soil Tilth Improvement practices	**Extension**; KRC; Cons. Districts; NRCS; SCC; KDHE; ; NEKES
Pesticide monitoring to track goal target success	Send letters of support to US Army Corps of Engineers and KDHE supporting continued monitoring efforts	USACE; KDHE	Annual reporting data shows decrease in mean concentration of pesticides	2017	N/A	**USACE;** KDHE

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Objective #2: Reduce pesticide contamination of water caused by urban pesticide use.						
Buffer zones around surface water in urban areas	Education; city ordinances establishing buffer zones	Urban residents; Golf courses; Cities and city employees; Lawn care professionals	Reduction in pesticide applications near surface water, causing reduced levels of pesticides in water	2010	N/A Net reduction in cost to urban residents	**Extension**; Lawn care organizations; Cons. Districts; SCC; NRCS; KDHE; KS Forest Service; KAWS; NEKES; KACEE; KDWP; USFWS; Watershed Districts
Backyard Conservation for urban lawns	Education and dissemination of information; demonstration areas	Urban residents; Lawn care professionals; Golf courses; Cities and city employees	Reduction in pesticide applications near surface water, causing reduced levels of pesticides in water	2010	See Outreach section	**Extension;** Lawn care organizations; KACEE; Cons. Districts; SCC; NRCS; KDHE; KS Forest Service; KAWS; NEKES; KDWP; USFWS
Setbacks in urban areas	Encourage cities to adopt ordinances that create setbacks zones around surface water, drainage-ways or wells	Cities and city employees; Lawn care professionals; Urban residents; Golf courses;	Reduction in pesticide applications near surface water, causing reduced levels of pesticides in water	2010	N/A Net reduction in cost to urban residents, cities	**Extension;** Lawn care organizations; KACEE; Cons. Districts; SCC; NRCS; KDHE; KS Forest Service; KAWS; NEKES; KDWP; USFWS; Watershed Districts
Proper disposal of pesticides	Education and HHW disposal programs	Urban residents; County weed departments; Cities and city employees; Lawn care professionals	See Household Hazardous Waste practices	See Household Hazardous Waste practices	See Household Hazardous Waste practices	**Extension; Counties and Tribes**; Lawn care organ-izations; KACEE; Cons. Districts; SCC; NRCS; KDHE; KS Forest Serv; KAWS; NEKES; KDA

Household and Farmstead Hazardous Waste

***GOAL*: Establish local Household Hazardous Waste (HHW) programs that safely recycle and dispose of hazardous chemicals in the entire Delaware River Watershed.**

***ISSUE*:** Of the five counties in the Delaware watershed, Jefferson and Nemaha counties have well-established hazardous waste disposal programs, and Jackson County has a small program started in 2003. Atchison and Brown Counties and the Kickapoo and Pottawatomie Tribes have no HHW program at all. These and other counties and tribes in the region are interested in developing disposal programs and/or joint disposal programs with neighboring counties.

It is estimated that the average Kansas household generates 15 pounds of hazardous waste per year. With over 26,000 households in the 5 counties around the Delaware River basin, that can translate into 196 tons of hazardous material generated each year. Although hazardous materials are very common items we use in our everyday life, they can be very toxic, flammable, corrosive or explosive, posing a danger to human health and the environment. Hazardous chemicals are often stored in sheds, garages or closets for many years, endangering humans when containers leak or chemicals become mixed. Materials such as mercury, volatile organic chemicals, solvents, insect and rodent poisons and a whole host of other hazardous chemicals find their way into water supplies when HHW is disposed of improperly in regular household trash, poured down sinks or dumped into storm water drains. Improper storage and disposal can expose sanitation workers to these dangerous materials, corrode plumbing, damage water treatment systems, pollute local streams and rivers, and harm aquatic life.

TARGET: Provision of a Household Hazardous Waste disposal program for all residents of Delaware River Watershed to provide proper disposal and prevent the release of these materials into the environment.

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Objective #1: Establish Farmstead and Household Hazardous Waste programs that have annual budgets sufficient to meet disposal needs of all counties and of the Indian tribes in the region.						
Start up HHW collection and disposal program in every county and tribal reservation area	Establish county and/or regional disposal program for all counties and tribes in watershed; obtain KDHE Bureau of Waste Management start-up grants for program(s)	AT, BR, JA and JF County Commissioners; Co. Solid Waste personnel; Tribal Councils	All counties/ tribes in the region start an HHW disposal program by 2009	Approx. $15,000/county or tribe (3 cos., 2 tribes in watershed joining in regional program, $60,000)	Start-up costs variable by population served	**KDHE; County Commissioners; Tribal governments**; NEKES; EPA; KDA; Glacial Hills RC&D

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
On-going HHW disposal program in every county and tribal reservation area	Respective counties/tribes allocate a yearly budget to run their individual program	AT, BR, JA, JF & NM County Commissioners; Tribal Councils	All counties/ tribes maintain a yearly HHW disposal program by 2009	Approx. $42,500 per year	$8,500 to $10,000 annually	**County Commissioners; Tribal governments**; NEKES; EPA; KDA; KDHE; Glacial Hills RC&D
Agricultural Clean Sweep Program	Sponsor a Clean Sweep Program for the watershed region	Farmers (no fee); pesticide dealers, manufacturers and distributors (for a fee)	Ag Sweep Program for the watershed by 2010	TBD	Approx. $1.00/ pound of pesticide collected	**KDHE;** KDA; County comm. and solid waste personnel; Glacial Hills RC&D
Objective #2: Develop joint working relationships between counties and tribal governments in the watershed and surrounding region to form a Farmstead and Household Hazardous Waste regional disposal program.						
Regional HHW program	Facilitate working relationships and inter-local agreements between counties and tribal governments in the region to form a regional disposal program	Atchison, Brown, Doniphan, Leavenworth, Jackson, Jefferson and Shawnee counties, Kickapoo, Sac & Fox, Iowa and Pottawatomie Tribes (NM Co. is already in a regional HHW program)	Counties and Indian tribes in the region	2009	N/A	**Counties and Indian tribes in the region (not necessarily only those within the Delaware watershed); Glacial Hills RC & D;** KDHE; EPA

Water Wells

GOAL: Protect groundwater and drinking water wells in the watershed from contamination.

1. Public Water Supply Wells:

I SSUE: There are 22 public water supplies (PWS) in the Delaware watershed. With the exception of the Kickapoo Indian Reservation which draws its water from the Delaware River west of Horton, all use groundwater or a mixture of groundwater and surface water to supply their water needs. Only two PWS's (City of Nortonville and Nemaha County RWD #4) have source water protection plans developed for their wells. The Kansas Rural Water Association (KRWA) offers free assistance to public water supplies to develop wellhead protection plans. Source Water Assessment (SWA) data pinpointing potential pollution sources for all PWS's in the watershed is readily available from KDHE to assist in source water protection planning and implementation.

TARGET: Develop and implement Wellhead Protection Plans (WHPP) for all PWS's utilizing groundwater in the Delaware watershed.

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Objective #1: Ensure that all public water supplies using wells adequately protect their wellheads by 2013.						
Wellhead Protection Plans (WHPP)	Educate PWS operators about resources available; facilitate development of WHPP between PWS's and KRWA	All PWS's in the watershed	*Organize at least one meeting with all PWS's in the watershed *5 years *$12,500	Starting in 2007	$2500 per year	**PWS's; KRWA**; NEKES; KDHE; Groundwater Foundation;
Wellhead Protection Plans (WHPP)	PWS's using groundwater develop individual WHPP's for their supply wells	All PWS's in the watershed	*All PWS's in the watershed develop WHPP *5 years	5 PWS's per year	N/A	**PWS's; KRWA**; NEKES; KDHE; Groundwater Foundation;

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Implementation of WHPP's	Implementation of protective action identified by WHPP's	PWS's; landowners, ag producers, business and industry in WHPP zones	Full implementation of WHPP plans within 3 years of plan development	2015	Variable Estimate $1000/ year per PWS (?)	**PWS's; KRWA**; NRCS; Cons. Districts; KS Forest Service; KDHE; SCC; Counties; NEKES; KDWP; Groundwater Foundation; KAWS; KRC
Demonstration Project	Use a PWS's WHPP development process and Implementation of Plan as demonstration project	PWS's; landowners, ag producers, business and industry in WHPP zones	One PWS used as a demonstration project	2008	N/A	**PWS's; KRWA**; NRCS; Cons. Districts; KS Forest Service; KDHE; SCC; Counties; NEKES; KDWP; Groundwater Foundation

2. Private Water Supply Wells:

ISSUE: There are approximately 450 private wells used for drinking water in the Delaware Watershed. The exact location and condition of these wells, and the quality of water being used is unknown since these wells are unregulated. Unplugged, abandoned wells are common, and pose a potential danger to groundwater throughout the watershed. The exact number and location of these abandoned wells is unknown. Proper well location and construction are critical to protecting human health and groundwater quality in the region.

***TARGET*:** Safe drinking water for all watershed residents using private wells as their water supply.

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
<u>Objective #1</u>: Protect groundwater quality by plugging abandoned wells.						
Locate abandoned wells	Create an inventory of abandoned well sites (wells landowners don't use but wish to keep "open" can be registered with KDHE and kept "open")	Landowners	See "SERVE" project in FCB Issue	See "SERVE" project in FCB Issue	See "SERVE" project in FCB issue	**NEKES**; KDHE; JF Co. Health Dept.; SCC; Cons. Districts; NRCS; Extension; KGS; USGS; Groundwater Foundation
Plug abandoned wells	Contact landowners with abandoned wells; provide TA and cost share assistance to plug wells	Landowners	*Plug all know abandoned wells *10 years *$500,000	100 wells plugged per year (approx. 50,000/year)	$600 per well maximum	**SCC; Cons. Districts; NRCS; NEKES; JF Co. Health Dept**.; KGS; USGS; Extension; Groundwater Foundation' KDHE
<u>Objective #2</u>: Protect groundwater quality and human/livestock health by making sure that all wells are located and constructed correctly, and water from private wells used for drinking water is tested annually.						
Water well testing	Education and cost share/rebate program for getting private wells tested on a regular basis	Well owners and users	*Private wells tested at least once per year (1,000 wells tested) *5 years *$25,000	200 wells tested per year (approximately $5,000/year)	$25 per well test	**NEKES; Extension**; Cons. Districts; SCC; Citizen Science; JF Co. Health Dept.; KDHE; Groundwater Foundation KGS; USGS;

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Proper well location	Education on proper well location; education and cost share to plug/relocate poorly located wells, or connect to rural water	Well owners; well drillers	*Proper location of new wells; poorly located wells plugged, relocated or alt. water supply *5 years *$75,000	5 systems per year (approx. $25,000/year)	$2,500 per relocated well; $600 per plugged well $5000 max./year per person	**KDHE; NEKES; Extension; Well Drillers;** SCC; KRC; Cons. Districts; JF Co. Health Dept.; Groundwater Foundation; KGS; USGS;

Point Source Pollution - Public Wastewater Treatment Plants

***GOAL*: Ensure that all point source pollution sources, especially public wastewater treatment plants (WWTP's), are in compliance with their NPDES permit requirements.**

ISSUE: There are eight WWTP's in the watershed identified by EPA and KDHE as having treatment plant, collection line or other facility upgrade needs totaling at least $6.5 million. This "Needs List" includes WWTP's for the City of Everest, City of Horton, City of Ozawkie, City of Wetmore, Jefferson County Sewer District #6 Lake Shore Estates, Jefferson County Sewer District #7 Lake Ridge Estates, Lakewood Hills Improvement District, and Lakeside Village Improvement District. The City of Holton, City of Sabetha and Jefferson County Sewer District #2 recently completed upgrades costing in excess of $7 million.

***TARGET*:** Potential funding sources for such improvement projects include Community Development Block Grant Program, KS Water Pollution Control Revolving Fund, USDA's Rural Development Agency, Rural Utilities Service, KS Dept. of Commerce & Housing, Public Works and Development Facilities Program and others. Competition for funds is fierce, but priority should be given to small systems in targeted watersheds such as the Delaware watershed.

BMP or Method to Achieve Goal	Actions Necessary to Implement BMP	Target Audience	Long Term Implementation Target/Cost	Short Term Implementation Target/Cost	Estimated Cost Basis	Cooperating or Responsible Agencies and Groups
Objective #1: Assist small WWTP's in obtaining necessary funding to upgrade facilities so that they meet requirements of their NPDES permits by 2015.						
Upgrade WWTP's to NPDES permit standards	WWTP's on the "Needs List" given highest priority when funding decisions are made so that adequate funding is obtained	Funding agencies and WWTP's on the "Needs List"	*All facilities on the list upgraded and meeting permit requirements *7 years *$6.5 million	Average of $920,000 per year	$6.5 million	Owners of **WWTP's** on the List; Funding agencies; KDHE; Jefferson Co. Health Dept.; NEKES; EPA
Best alternative treatments evaluation	Engineering studies to evaluate each system's needs and assess what the best alternatives are based on cost/benefit	Individual WWTP's; KDHE;	*Best treatment alternative for all WWTP's on the "Needs List" *$60,000	Average of $20,000 per year	$7500 per system	Owners of **WWTP's** on the List; Funding agencies KDHE; Jefferson Co. Health Dept.; NEKES; EPA

The Outreach Plan

Stakeholders recognized the importance of a good outreach program early in the development of the Delaware River Watershed Restoration and Protection Strategy (WRAPS) plan. As issues were discussed, the important role that information and education would play in solutions to problems became clear. This **Outreach Plan** was developed as a separate component of the WRAPS plan because of its great importance to the overall success of WRAPS.

Information itself is useful and is a crucial element of water education, but it is not education in and of itself. Water problems and issues are complex, and solutions frequently have scientific, economic, historical, political, and cultural aspects. An effective outreach program helps citizens sort through the sometimes biased and emotional elements of water issues, weigh all sides, and make informed, balanced, and locally-appropriate decisions. It affects attitudes and actions in addition to simply informing. It is also the means by which individuals and groups in the watershed are linked with technical and financial resources to help them take steps toward resource protection. Information and education put together in a good outreach program promote balanced decisions and responsible action that lead to stewardship and the long-term sustainability of WRAPS projects.

One of the first things this **Outreach Plan** seeks to accomplish is to raise awareness about the Delaware River watershed, the WRAPS project and water problems in the watershed. Understanding how watersheds work, that we are all members of a watershed community, and that everyone has a role to play in protecting and restoring watershed resources is also important in raising awareness. With this in mind, the Outreach Plan is divided into sections, the first of which is titled "Watershed-Wide Outreach". This section targets basic WRAPS and watershed education and awareness. The sections following the Watershed-Wide Outreach actions relate to the seven water issues that were identified for the watershed, as discussed earlier in this document. These sections are listed in the order of issue priority. Objectives and action items within each section are also listed in order of priority as determined by stakeholders. The information is presented in chart form to ease viewing of the actions planned.

Wherever possible, existing materials, delivery mechanisms and information will be used. Many agencies in northeast Kansas have a long track record of providing excellent outreach and assistance to residents. Additional effort to reach specific audiences with information about WRAPS issues and refocusing of existing programs to address priority issues will be necessary in some cases. In other instances, entirely new materials and outreach will be needed.

There are 15 public school districts and 6 private schools in the Delaware River watershed. Schools can be very important partners in outreach, and educating students and educators about WRAPS, water and other natural resources issues is an important element of this outreach plan. For this reason, many of the actions of the outreach program will be directed at and tailored to schools, educators and students.

WRAPS Outreach Partners	Conservation Districts, Glacial Hill Resource Conservation & Development (RC&D), Local School Districts, Kansas Alliance for Wetlands and Streams (KAWS), Kansas Association for Conservation and Environmental Education (KACEE), Kansas Department of Health and Environment (KDHE), Kansas Department of Wildlife and Parks (KDWP), Kansas Forest Service (KFS), Kansas Foundation for Agriculture in the Classroom (KFAC), Kansas Rural Center (KRC), Kansas Stream Link, Kansas WaterLINK, Kansas Water Office (KWO), Northeast Kansas Environmental Services (NEKES), Local Health Departments, Local Extension Offices, Natural Resources Conservation Service (NRCS), State Conservation Commission (SCC), U.S. Army Corps of Engineers, Kansas Department of Agriculture (KDA), Kansas Rural Water Association (KRWA), Watershed Districts.

Watershed-wide Outreach Program

GOAL:	Increase awareness of what a watershed is, of the Delaware River Watershed and WRAPS, of resources available through the WRAPS program, and that everyone is a member of a watershed community.

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	**Develop a website, resources, and links to other informational resources/agencies, and other materials to provide a resource center for watershed residents, schools, educators and students in watershed.**			
Action #1-1	Develop a website for the Delaware River WRAPS project; provide links to associated resources/agencies on the website.			
Teachers and students in grades K-12; other watershed residents and absentee landowners	Website for Delaware River WRAPS; website to be linked to Kansas WRAPS, SCC, KDHE, and other web resources	2007	$3,000	Developed by Glacial Hills Resource Conservation & Development (RC&D) Associated links: WRAPS Partners
Action #1-2	Develop a logo and mascot for the Delaware River WRAPS project.			
Educators, students, and residents in the watershed area	Identifiable and recognizable logo and mascot, to be placed on website, brochures, and any written material	2007	N/A	U.S. Army Corps of Engineers and other WRAPS partners
Action #1-3	Set up a library of brochures, publications and other resources to be made available to schools and watershed residents who are seeking information about water quality, best management practices, technical and financial assistance, etc, in a central location. Also establish a contact list of persons, agencies or other groups to provide assistance to watershed residents.			
Educators students, and residents in the watershed area	Library of information and contacts (also listed on the website)	2008 (updated monthly or as needed)	$2,500	Glacial Hills RC&D, KACEE, Extension, KDWP, Conservation Districts, SCC, NRCS, KDHE, KRC, Watershed Districts, U.S. Army Corps of Engineers and other WRAPS partners
Action #1-4	Participate in Career Days activities for students in the fields of water and natural resources.			
Educators and students in the watershed area	Participate in area Career Days activities for students (also list career opportunities on website)	2008	TBD	WRAPS Partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Action #1-5	Post a "Calendar of Events", listing events related to WRAPS, the watershed and natural resources in the watershed.			
Educators, students, and residents in the watershed	List of all natural resources events in the watershed area; post on the website	2007-2008 (updated monthly or as needed)	Updating costs TBD	WRAPS Partners
Objective #2:	**Develop outreach resources and information specific to the Delaware River WRAPS project; utilize this material in local media outlets and community events to keep residents informed about WRAPS and water issues.**			
Action #2-1	Develop a WRAPS newsletter to be sent to all residence in the watershed.			
Watershed residents and absentee landowners	Newsletter mailed out twice per year.	Beginning 2008, thru 2013	$3,000 per newsletter (total $30,000 for 5 years)	WRAPS partners
Action #2-2	Develop a traveling/portable display for the Delaware River WRAPS project to take to schools, county fairs, festivals and other public events.			
Educators, students, and other watershed residents	Traveling/portable display	2008	$2,000	Glacial Hills RC&D, Kansas WaterLINK, Conservation District and/or other WRAPS partners
Action #2-3	Write newspaper articles to be published in local newspapers in the watershed.			
Readers of local newspapers in the watershed and surrounding area	4 newspaper articles per year	2007 and each year thereafter	N/A	Kansas WaterLINK, local newspaper and/or other WRAPS partners
Action #2-4	Develop articles or inserts about WRAPS to be included with Conservation District, Extension and school newsletters.			
Educators, students, Conservation District and Extension Service patrons	At least 1 article or insert with each school, Conservation District and Extension newsletter each year.	Beginning 2008, thru 2013	$2,000 per year, total $10,000 for 5 years	Conservation Districts, Extension Offices and/or other WRAPS partners
Action #2-5	Contact absentee landowners to raise awareness of WRAPS goals, activities, programs and BMP's.			
Absentee landowners with land in Delaware River Watershed	2 contacts (newsletters or other contacts aimed specifically at absentee landowners per year)	Beginning 2008, thru 2013	$2,000 per year, total $10,000 for 5 years	Glacial Hills RC&D, Center for Absentee Landowners (50% cost share grant possible) Kansas WaterLINK, Conservation District, and other WRAPS partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Action #2-6	Develop posters about the Delaware Watershed and water issues; place in local schools and community gathering places within the watershed such as post offices, schools, grocery stores, farm supply stores, etc.			
Educators, students and other residents in the watershed area	Posters (developed by students) placed in visible locations in schools and communities	2008	$1,000	Kansas WaterLINK, local schools, Glacial Hills RC&D, and/or other WRAPS partners
Action #2-7	Develop watershed activity games to be presented and used in schools and other places, or checked out of resource library.			
Educators and students in the watershed area	Games such as Jeopardy, Incredible Journey, and other watershed games	Develop 1 or 2 games per year for 5 years	Up to $100 per game	Conservation Districts, KACEE and other WRAPS Partners
Action #2-8	Develop brochures for the Delaware Watershed and the WRAPS project.			
Watershed Residents	1 brochure for the Delaware watershed and 1 brochure on WRAPS projects and BMP's	2007 for Watershed brochure; 2008 for projects/BMP's brochure	$5,000 per brochure	KACEE, Kansas WaterLINK, Extension and other WRAPS partners
Action #2-9	Utilize Public Service Announcements (PSA's) to publicize Delaware River WRAPS activities and BMP implementation.			
Local TV, radio and other media	3 general PSA's per year; others as needed for WRAPS events	2007 and each year thereafter	N/A	WRAPS partners
Action #2-10	Develop inserts to be placed in newspapers and water bills of watershed residents.			
Watershed residents	2 newspaper inserts and 1 water bill insert or attachment	Beginning 2008, thru 2013	$2,000 per year, total of $10,000 for 5 years	Water utilities, local newspapers
Action #2-11	Develop a "Calendar of Events" (paper copy that students would help to develop) to be distributed to agencies and organizations in the watershed.			
Educators and students in the watershed area	List of all natural resources events in the Delaware watershed area.	Beginning 2008, thru 2013	$2,000 per year, total $10,000 for 5 years	Schools and students, WRAPS Partners
Action #2-12	Develop and/or disseminate watershed curricula materials and WRAPS information to local schools and educators.			
Teachers and students in grades K-12	5 Teacher In-Service/year Use materials like Discover-A-Watershed, Project WET, and others	Beginning 2008; all schools by 2013	TBD	School districts, KACEE, Extension, Conservation Districts and other WRAPS Partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Action #2-13	Develop and distribute placemats to local restaurants with a watershed map and information printed on them about the Delaware River watershed.			
Patrons of local restaurants	Placemats in all area restaurants	2008	$2,500	Local restaurants, Conservation Districts, Glacial Hills RC&D and Tourism Alliance, Kansas WaterLINK, Department of Commerce, Economic Development, local chambers of commerce and other WRAPS partners
Action #2-14	Place billboards about the Delaware Watershed at 8 visible locations on major highways in the watershed.			
Watershed residents and travelers	Billboards on eight major highways in the watershed (Highways 24, 36, 73, 9, 16, 116, 75, and 159)	2008	$5,000 per billboard, total of $40,000	Kansas WaterLINK, Glacial Hills RC&D and Tourism Alliance, Department of Commerce, KDOT and other WRAPS partners
Action #2-15	Work with local historians to create "human interest" articles for local newspapers (conduct interviews and develop stories related to history of water bodies, water and land uses, etc.).			
Educators, students and watershed residents	2 "human interest" stories per year	Beginning 2008, thru 2013	N/A	Local historical societies, schools, museums and history organizations, other WRAPS partners
Objective #3:	**Provide field trips and hands-on learning opportunities, assemblies, etc. to classrooms and watershed residents on watershed and implementation of BMP's.**			
Action #3-1	Organize and conduct tours to show examples of best management practice implementation on local farms and homes, in businesses and communities.			
Agriculture producers	1 "farm tour" per year focused on agricultural BMP's	Beginning 2007, thru 2013	$1,500 per tour, total of $7,500 for 5 years	KRC, Extension, Conservation Districts, NRCS, K-State and other WRAPS partners
Watershed residents, especially urban residents	1 tour per year focused on urban BMP's	Beginning 2008, thru 2013	$1,500 per tour, total of $7,500 for 5 years	KRC, Extension, Conservation Districts, NRCS, Glacial Hills RC&D and Tourism Alliance and/or other WRAPS partners
Action #3-2	Hold a water festival or other celebration for the watershed.			
All watershed residents	Perry Lake Festival or other water festival for the entire watershed	2007	$7,500 - $12,500	KACEE, Conservation Districts and all other WRAPS Partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Action #3-3	Develop a powerpoint presentation with an introduction to WRAPS and pictures of BMP's or demo sites to provide "armchair tour" of the watershed and WRAPS projects.			
Watershed residents, students and educators	One Powerpoint presentation	2008	$500	WRAPS Partners
Action #3-4	Provide educational programs to educators, students and other organizations about WRAPS and watershed issues.			
Teachers and students in grades K-12, civic organizations	Present educational program to schools or teacher groups; utilize and/or raise awareness of other opportunities such as Control Tower Tours at Perry Lake, Delaware Marsh Habitat Walk, Environmental Festival, Range Youth Camp, Kansas Envirothon, PLT, Project Wet, Project Wild, Earth Day Celebration, etc.	At least one educational program/workshop per county per year	TBD	Schools, KACEE, Kansas Foundation for Ag in the Classroom, Extension, KDWP, Conservation Districts, SCC, NRCS, KDHE, KRC, Watershed Districts, U.S. Army Corps of Engineers and other WRAPS partners

Outreach Related to Sedimentation

GOAL:	Educate watershed residents and landowners about how to reduce sedimentation of area lakes through steps they can take as individuals.

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	**Utilize "Backyard Conservation" and other similar available print materials to promote sedimentation controls in both urban and rural settings.**			
Action #1-1	Send information on sediment controls that are proven to work in the area to all watershed residents (utilize existing material wherever possible).			
Educators, students and residents of cities and towns in watershed	One contact per household and per educator per year	Beginning 2008 thru 2013	$2,000/year, total $10,000 for 5 years	KDHE, Extension, Conservation Districts, NRCS, SCC, KACEE, KRC, Watershed Districts, KS Forest Service, KDWP, U.S. Army Corps of Engineers, and other WRAPS partners.
Landowners in watershed	One mailing of information on buffer strips, wetlands, soil tilth improvement, etc. related to controlling sediment in rural/ag settings	2008	$2,000/year, total $10,000 for 5 years	Conservation Districts, SCC, NRCS, Extension, KAWS, KRC, KDA, KDHE, Watershed Districts, KS Forest Service, U.S. Army Corps of Engineers, and other WRAPS partners
Objective #2:	**Sponsor a "Save the Lake" festival for Perry Lake.**			
Action #2-1	Obtain grant to hold a festival at the Lake in summer of 2007; involve WRAPS partners and other organizations to provide information, booths, etc.			
Watershed residents, landowners, and people who recreate at Perry Lake	Perry Lake Festival (see Action # 3-2 in Watershed-Wide Outreach)	See Action # 3-2 in Watershed-Wide Outreach	See Action # 3-2 in Watershed-Wide Outreach	KACEE and all other WRAPS Partners
Objective #3:	**Set up demonstration sites showing erosion control practices in visible locations throughout the watershed.**			
Action #3-1	Work with landowners who have installed buffer strips, stream bank stabilization practices or other erosion control practices to promote these practices in visible location in the watershed.			
Residents, landowners and travelers	Four sites with signs	2010	$500/site, total of $2,000	Conservation Districts, SCC, NRCS, Extension, KACEE, KRC, Watershed Districts, KS Forest Service, and other WRAPS partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Action #3-2	Show the effectiveness of stream bank stabilization practices in the watershed; develop powerpoint and other information to show stabilization effects over time.			
Watershed residents and landowners	Before/after buffer strip and stream bank stabilization project demo, powerpoint presentation and brochure	2012	$5,000	Conservation Districts, SCC, NRCS, Extension, KRC, Watershed Districts, KS Forest Service, U.S. Army Corps of Engineers, other WRAPS partners
Objective #4:	**Provide stream bank erosion and stabilization educational opportunities for residents, schools and educators in the watershed.**			
Action #4-1	Hold workshops and other "hands-on" educational opportunities for watershed residents, schools and civic organizations.			
Landowners and operators with land along streams	Stream bank stabilization workshop, one per year	Beginning 2008 thru 2013	$2,000/workshop, total of $10,000 for 5 years	Conservation Districts, SCC, NRCS, Extension, KAWS, KRC, Watershed Districts, U.S. Army Corps of Engineers, and other WRAPS partners
Landowners with land along streams, schools and other civic organizations	Provide service learning opportunities for schools and civic organizations	Beginning 2008 thru 2013	N/A	Conservation Districts, SCC, NRCS, Kansas WaterLINK, Extension, KAWS, KRC, Watershed Districts, U.S. Army Corps of Engineers, and other WRAPS partners
Objective #5:	**Increase awareness of county commissioners and road and bridge departments about BMP's for erosion control and stream bank stabilization.**			
Action #5-1	Contact county commissioners and road and bridge departments with a letter stating WRAPS goals, with information about erosion control BMP's for road and bridge projects and other county projects.			
County Commissioners and Road/Bridge Departments of 5 counties in Delaware River watershed area	Letter to road/bridge departments; attend County Commissioner meetings and address BMP's	Beginning 2008 thru 2013	$500/year, total $2,500 for 5 years	Counties, Extension, KDOT and other WRAPS partners

Outreach Related to Nutrient Management

GOAL:	Encourage adoption of livestock waste, nutrient management, and other practices to reduce nutrient loading of water bodies in the watershed.

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	**Establish demonstrations to illustrate agricultural practices that reduce nutrient loading of streams and lakes.**			
Action #1-1	Set up demonstration plots or farms where soil tilth improvement and other cropland nutrient management methods are employed.			
Crop producers	Two plots or "farms" per year for five years	Beginning 2008 thru 2013	$5,000 per farm for total of $50,000 in 5 years	KRC, Extension, Conservation Districts, NRCS, SCC, KDA, Livestock Associations, No Till on the Plains, and other WRAPS partners
Action #1-2	Set up livestock waste control demonstration sites on farms utilizing innovative waste control methods such as constructed wetlands, filter strips, composting, etc.			
Livestock owners in the watershed	Two sites per year for five years	Beginning 2008 thru 2013	$5,000 per site for total of $50,000 in 5 years	KRC, Extension, Conservation Districts, NRCS, SCC, KDA, Livestock Associations, KAWS, KDWP, USFWS, and other WRAPS partners
Objective #2:	**Provide easy access to and information about soil and waste testing resources.**			
Action #2-1	Include information on the website along with links to other sites and informational resources on soil/waste testing.			
Residents, crop producers and livestock owners	Information and links to resources on Delaware River WRAPS website	2008	N/A (cost included in website development)	KRC, Extension, Conservation Districts, NRCS, SCC, KACEE and other WRAPS partners
Objective #3:	**Provide comparisons of "resource friendly" farming and livestock techniques that reduce nutrient loading of water.**			
Action #3-1	Publish case studies of local farmers who utilize livestock wastes and soil tilth improvement methods, with financial comparisons, crop yield comparisons, erosion, water quality and farm income data.			
Crop producers and livestock owners in the watershed	Three study farms over five year period	Start in 2008, thru 2013	Estimate $10,000 per farm, total of $30,000 over 3 years	KRC, Extension, Conservation Districts, NRCS, SCC, and other WRAPS partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #4:	**Contact lawn care and landscape professionals, and educate about WRAPS goals, lower fertilizer use and methods to reduce fertilizer contamination of water.**			
Action #4-1	Send information about WRAPS, WRAPS goals and effective fertilizer use and management techniques.			
Lawn care, landscape professionals, and golf courses	One contact per year over the next five years	Beginning 2008 thru 2013	$1,000 per year, total of $5,000 for 5 years	Extension, Conservation Districts, NRCS, SCC, KDA, KDHE, KACEE, Lawn Care professional organizations, Chemical dealers and other WRAPS Partners
Objective #5:	**Educate urban residents and home owners about proper fertilizer use and ways they can reduce fertilizer contamination of water.**			
Action #5-1	Utilize information such as “Backyard Conservation” and “Backyard Habitat” or others to educate urban residents.			
Urban residents in the watershed	Send "Backyard Conservation”, “Backyard Habitat" and other related material on fertilizer/nutrient contamination reduction to all urban residents (at least one mailing/contact per year)	Beginning 2008 thru 2013	$2,000 per year, total of $10,000 for 5 years	Extension, Conservation Districts, NRCS, SCC, KDA, KDHE, KACEE, Lawn Care professionals, National Wildlife Federation, Kansas Wildlife Federation and other WRAPS Partners

Outreach Related to Fecal Coliform Bacteria

GOAL:	Increase awareness of bacterial contamination of water resources and ways individuals can act to control it.

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	**Ensure that all households in the watershed not on community sewer collection systems and wastewater system installers receive information about proper on-site wastewater disposal methods and WRAPS.**			
Action #1-1	Mail information to residents not on community sewer collection systems about proper wastewater disposal, system maintenance and how to do an evaluation of their on-site wastewater system and needs.			
Watershed residents not on community sewer collection systems	One mailing per year	Beginning 2008 thru 2013	$2,000/year, total of $10,000 for 5 years	NEKES, JF County Health Department, SCC, Extension Service, Conservation Districts, KRC, KAWS and other WRAPS partners
Action #1-2	Contact wastewater system installers about WRAPS and its goals.			
Wastewater system installers	At least one contact per year	Beginning 2008 thru 2013	$500/year, total of $2,500 for 5 years	NEKES, JF County Health Department, SCC, Extension Service, Conservation Districts, KRC, KAWS and other WRAPS partners
Objective #2:	**Educate livestock producers in the watershed about low cost/no costs methods and other BMP's to reduce bacterial contamination of water by livestock waste.**			
Action #2-1	Send information to all livestock producers on ways to reduce bacterial contamination of water.			
Livestock owners in the watershed	Two educational mailings per year	Beginning 2008 thru 2013	$2,500/year, total of $12,500 for 5 years	KAWS, Glacial Hills RC&D, Extension, SCC, Conservation Districts, KRC, KDA, NRCS, KDHE, Livestock Associations, and other WRAPS partners
Action #2-2	Hold workshops on low cost/no cost methods and other BMP's that reduce bacterial contamination of water.			
Livestock owners in the watershed	Two workshops per year on low cost/no cost FCB controls	Beginning 2008 thru 2013	$1,000/workshop, $5,000 for 5 years	SCC, Extension, Conservation Districts, KRC, KAWS, KDA, KDHE, NRCS, Livestock Associations, Glacial Hills RC&D and other WRAPS partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Action #2-3	Establish demonstration sites in the watershed illustrating practical bacterial and nutrient contamination controls related to livestock.			
Livestock owners in the watershed	Two demo sites established per year working with producers who've installed BMP's	Beginning 2008 thru 2013	$1,000/site, $2,000 per year, total of $10,000 for 5 years	Extension, Conservation Districts, SCC, KRC, KAWS, KDA, NRCS, Livestock Associations, Glacial Hills RC&D and other WRAPS partners
Objective #3:	**Utilize the Delaware River WRAPS website as a tool to inform watershed residents on fecal coliform bacteria controls.**			
Action #3-1	Include information on Delaware River WRAPS website specific to reducing bacterial contamination, including a list of BMP's, list of cost-share programs to address FCB contamination, links to available resources, information on completed projects completed in the watershed, links to Jefferson Co., list of wastewater installers, and other.			
Livestock, on-site wastewater system owners and others	Information and links to resources on reducing bacterial contamination on Delaware River WRAPS website	2007	N/A (costs included in website development)	SCC, Extension, Conservation Districts, KRC, KAWS, KDA, NRCS, Livestock Associations, Glacial Hills RC&D and other WRAPS partners

Outreach Related to Pesticides

GOAL:	Increase awareness of proper pesticide use and pesticide contamination reduction techniques, and encourage use of non-chemical methods to control pests.

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	**Re-emphasize pesticide contamination reduction methods (setbacks, timing, application methods, etc.) and other effective practices that were employed when the Pesticide Management Area (PMA) order went into effect in 1992.**			
Action #1-1	Research and use existing materials and/or develop new material specific to the Delaware River Watershed on the "Top BMP's for Pesticides", similar to "12 BMP's for Atrazine".			
Pesticide users in the watershed, including farmers' cooperatives and other custom pesticide applicators	Distribute a "Top BMP for Pesticides" or similar material to all agricultural pesticide users	Beginning 2008 thru 2013	$2,000 per year, total $10,000 for 5 years	Extension, Conservation Districts, NRCS, SCC, KDA, KDHE, Chemical dealers, farmers' coops and other WRAPS Partners
Objective #2:	**Contact lawn care and landscape professionals, and educate about WRAPS goals, lower pesticide use methods and non-chemical control of pests.**			
Action #2-1	Send information about WRAPS, WRAPS goals and effective pesticide management techniques.			
Lawn care, landscape professionals, and golf courses	One contact per year over the next five years	Beginning 2008 thru 2013	Coordinate with Action #4-1 under Nutrient Management Outreach	Extension, Conservation Districts, NRCS, SCC, KDA, KDHE, KACEE, Lawn Care professional organizations, Chemical dealers and other WRAPS Partners
Objective #3:	**Educate urban residents and home owners about proper pesticide use and non-chemical control of pests.**			
Action #3-1	Send information such as "Backyard Conservation" and "Backyard Habitat" or others to urban residents.			
Urban residents in the watershed	Send "Backyard Conservation", "Backyard Habitat" and other related material on pesticide contamination reduction to all urban residents	Beginning 2008 thru 2013	Coordinate with Action #5-1 under Nutrient Management Outreach	Extension, Conservation Districts, NRCS, SCC, KDA, KDHE, KACEE, Lawn Care professionals, National Wildlife Federation, Kansas Wildlife Federation and other WRAPS Partners

Outreach Related to Household and Farmstead Hazardous Waste

GOAL:	Increase awareness of Household Hazardous Waste (HHW), what items are considered HHW, proper disposal, and of available disposal programs.

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	Work with county and/or regional HHW program(s) in the watershed on an HHW educational program.			
Action #1-1	Assist counties and tribes with publicity about HHW programs; provide educational assistance about HHW and illegal trash dumps to watershed residents and schools.			
Watershed residents, schools and educators	Distribute HHW educational materials from KDHE schools and educators	Beginning 2008 thru 2013	$3000 per county per year, total of $45,000 over 5 years	KDHE, Counties, Indian Tribes, NEKES, Extension, Conservation Districts, NRCS, SCC, EPA and other WRAPS partners
Watershed residents	Advertising/informational programs for HHW disposal programs in region and all environmental education programs	Beginning 2008 thru 2013	$1,000 per year, total of $5,000 for 5 years	KDHE, Counties, Indian Tribes, NEKES, Extension, Local media and other WRAPS Partners
Watershed residents	Provide links on WRAPS website to KDHE and information on how to deal with illegal dumps	2007	N/A (included in website development costs)	KDHE, Counties, NEKES, and other WRAPS partners

Outreach Related to Water Wells

GOALS:	**(1) Educate private well owners about well testing, proper well construction and location, and abandoned well plugging as a way to ensure wells and aquifers are protected from contamination.** **(2) Educate public well owners/operators about WRAPS goals and how to protect source water from contamination.**

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	**Identify private well owners/users in the watershed.**			
Action #1--1	Work with NEKES, Jefferson Co. Health Department, KDHE and local Conservation Districts to identify location of active private wells in the watershed.			
Well owners/users	Inventory of private wells in the watershed	Beginning 2008, thru 2011	$5,000 for 3 years	NEKES, KDHE, JF County Health Department, Extension, Conservation Districts, NRCS, SCC and other WRAPS partners
Objective #2:	**Educate private well owners and users about well testing and proper well maintenance.**			
Action #2-1	Provide educational materials to private well owners and users in the watershed including well testing, availability of well test kits and information, how to evaluate well location and construction/condition to prevent contamination.			
Well owners/users	One contact per year	Beginning 2008, thru 2013	$2,000 each year, total of $10,000 for 5 years	KDHE, Extension, KRC, NEKES, Jefferson County Health Dept., SCC, Conservation Districts and other WRAPS partners
Well owners/users	Well test kits and information for well users	Beginning 2008, thru 2013	$50/test kit, est. 50 kits, $2,500/year, $7,500 for 5 years	Extensions, KRC, KDHE, Schools and other WRAPS partners
Well owners/users	Link on WRAPS website to well information and testing information	2008	N/A (included in website development costs)	Extensions, KRC, KDHE, and other WRAPS partners
Objective #3:	**Encourage and assist private well owners and users to do an evaluation of their own well.**			
Action #3-1	Mailing of information showing how to evaluate well's location, construction and condition; information on what to do about poor well citing and condition.			
Well owners/users	One contact per year	Beginning 2008, thru 2013	$2,000 each year, total of $10,000 for 5 years	KRC, Extension, KDHE, NEKES, JF County Health Department, Conservation Districts, SCC and other WRAPS partners

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #4:	**Abandoned well education for landowners.**			
Action #4-1	Provide abandoned well plugging information to rural landowners and residents in the watershed			
Landowners	1 contact per year	Beginning 2008, thru 2013	$2,000 each year, total of $10,000 for 5 years	Conservation Districts, NRCS, SCC, KDHE, Extension, KRC, KACEE and/or other WRAPS partners
Landowners	Hold well plugging demonstrations, at least one per county each year	Beginning 2008, thru 2013	$1,000 per demonstration (total of $5,000 per year, total of $25,000 for 5 years)	Conservation Districts, NRCS, SCC, KDHE, Extension, KRC, KACEE and/or other WRAPS partners
Objective #5:	**Raise awareness of public water supply (PWS) protection and planning assistance that is available.**			
Action #5-1	Contact all Public Water Supplies (PWS's) about WRAPS goals, utilization of Source Water Protection (SWA) data and Wellhead Protection Plan (WHPP) development assistance through KS Rural Water Ass'n, and implementation of protection plans.			
All PWS's in the Delaware watershed	One informational meeting per year to	Beginning 2007, thru 2013	$500 per meeting, total of $2,500 for 5 years	KRWA, Cities, Rural Water Districts and other PWS's, KDHE, KGS, other WRAPS partners
All PWS's in the Delaware watershed	Two informational mailings per year	Beginning 2007, thru 2013	$250 per mailing, total of $1250 for 5 years	KRWA, Cities, Rural Water Districts and other PWS's, KDHE, KGS, other WRAPS partners
Action #5-2	Set up a Source Water Protection demonstration site to illustrate how PWS's can protect their source water from contamination.			
All PWS's in the Delaware watershed	One demonstration site, utilizing a PWS that has developed and implemented a WHPP	2009	$2,500	KRWA, Cities, Rural Water Districts and other PWS's, KDHE, KGS, other WRAPS partners
Objective #6:	**Assist PWS's with education of the public about WHPP and other water protection programs.**			
Action #6-1	Assist PWS's with a WHPP plan education program			
All PWS's in the Delaware watershed	Education program implemented by each PWS	2013	TBD	KRWA, Cities, Rural Water Districts and other PWS's, KDHE, KGS, other WRAPS partners

Outreach Related to Point Sources

GOAL:	Ensure that all public Wastewater Treatment Plants (WWTP's) in the watershed are aware of WRAPS Goals and are operating according to permit requirements.

Target Audience	Implementation Target	Time Frame	Estimated Costs	Cooperating or Responsible Agencies and Groups
Objective #1:	**Provide WWTP owners/operators with information about WRAPS, its goals and assist WWTP's with meeting water quality goals.**			
Action #1-1	Letter to WWTP owners and operators with information about WRAPS, its goals and how WRAPS can assist WWTP's.			
All WWTP's in the watershed	Two contacts per year	Beginning 2007 thru 2012	$1,000/year, total of $5,000 for 5 years	KDHE, EPA, Cities and Sewer Districts, Funding agencies and/or other WRAPS partners
Action #1-2	Support WWTP's seeking to upgrade systems in obtaining financial assistance.			
All WWTP's upgrading treatment systems	Letter of support	TBD	N/A	KDHE, EPA, Cities and Sewer Districts, Funding agencies and/or other WRAPS partners

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Glossary of Terms

Algae Bloom - A rapid increase in the population of phytoplankton algae in an aquatic system. Algal bloom concentrations may reach millions of cells per milliliter of water and are usually the result of an excess of nutrients (particularly phosphorus and nitrogen). As more algae and plants grow, others die. The dead organic matter becomes food for bacteria that decompose it. The bacteria increase in number and use up the dissolved oxygen in the water. When the dissolved oxygen content decreases, many fish and aquatic insects cannot survive. Algal blooms are also a concern as some species of algae produce neurotoxins and cause taste and odor problems.

Argillotrophic – A special category describing a trophic (pertaining to nutrient status) state of high turbidity due to suspended clay particles in water that restricts the amount of light available to phytoplankton (algae) and macrophytic vegetation in lakes. In argillotrophic lakes, nutrient levels generally are quite high, but this high nutrient availability is not fully translated into high algal production due to limitations on availability of sunlight caused by the suspended soil particles in the water.

Biological Oxygen Demand - The amount of oxygen required by aerobic microorganisms to decompose the organic matter in a sample of water, such as that polluted by sewage. It is used as a measure of the degree of water pollution; also called biochemical oxygen demand.

Chlorophyll *a* - A plant pigment found in all higher plants, chlorophyll is the green coloring matter of leaves and plants that is essential to the production of carbohydrates by photosynthesis. Chlorophyll *a* occurs in a bluish-black form, $C_{55}H_{72}MgN_4O_5$.

Clean Water Act – The Clean Water Act was passed into law in 1972 and is the primary federal law in the U.S. governing water pollution. The act established water quality goals and set up the National Pollutant Discharge Elimination System (NPDES), which regulates point sources that discharge pollutants into waters of the United States. Another very important program under the Clean Water Act is EPA's Total Maximum Daily Load (TMDL) Program.

Eutrophication - The process by which a lake, pond, or stream becomes eutrophic (nutrient rich), typically as a result of mineral and organic runoff from the surrounding land. The increased growth of plants and algae that accompanies eutrophication depletes the dissolved oxygen content of the water and often causes a die-off of other organisms (a.k.a. fish kills)

Fecal Coliform Bacterial - Facultative anaerobic, rod-shaped, gram-negative bacteria. The presence of fecal coliform bacteria in water indicates that the water has been contaminated with the fecal material of man or other animals. Since other pathogenic organisms such as E. coli and giardia may be present due to fecal contamination, fecal bacteria are used as an indicator of contamination. Fecal coliform enter water through direct discharge of waste from mammals and birds, from livestock, agricultural and storm runoff, and from untreated human sewage. When levels are high there may be an elevated risk of waterborne gastroenteritis. Tests for the bacteria are cheap, reliable and rapid.

Household Hazardous Waste (HHW) - Waste materials that are generated from general household use that pose substantial or potential threat to public health or the environment, and generally exhibits one or more of the following characteristics: flammability, toxicity, is explosive or corrosive. HHW includes a wide variety of materials that are used in everyday life such as solvents, paints, auto fluids, cleaners, etc.

Hydrologic Unit Code (HUC) - A hydrologic unit code is a uniform number system used to identify watersheds in the country. A watershed's unique code identifies each of several levels of hydrologic classification within two-digit fields. The longer the HUC number is, the smaller the watershed and more refined the watershed description is. The HUC number for the Delaware River Watershed is an eight-digit number, 10270103.

Macroinvertebrate - A term referring to aquatic invertebrates including insects, crustaceans (e.g. aquatic snails) and worms that inhabit rivers, ponds, lakes, wetlands or oceans. Historically, their abundance and diversity have been used as an indicator of ecosystem health and local biodiversity. They are a key component

of the food chain. Most indices that are used to determine water quality rank various forms of benthic (bottom-dwelling) macroinvertebrates with respect to pollution sensitivity. The presence of pollution sensitive macroinvertebrates (e.g. mayflies, caddisflies and stoneflies) indicates that the body of water is healthy. Alternatively, the excessive presence of pollution tolerant macroinvertebrates (e.g. aquatic worms, leeches and blood worms) indicates poor water quality.

Macrophyte - A plant, especially an aquatic plant or algae, large enough to be visible to the naked eye.

Maximum Contaminant Level (MCL) – A standard that is set by U.S. EPA for drinking water quality. A Maximum Contaminant Level (MCL) is the legal threshold limit on the amount of a hazardous substance that is allowed in drinking water under the Safe Drinking Water Act.

National Pollutant Discharge Elimination System (NPDES) – The permit program, established by the Clean Water Act, that controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Individual homes that are connected to a municipal system or that use a septic system do not need an NPDES permit. However, industrial, municipal and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our nation's water quality.

Non-point Source (NPS) – A source of pollution that is not a single, identifiable source. Non-point source pollution comes from many diverse sources, making it more difficult to regulate and control. An example of NPS pollution would be urban runoff of oil and lawn chemicals, agricultural runoff of herbicides or livestock waste runoff from pastures.

Phytoplankton – The autotrophic (able to produce their own food via photosynthesis or chemosynthesis) component of the plankton (any drifting organism that inhabits water) that drift in the water column. Phytoplankton is a vital part of the food chain in aquatic ecosystems. The name comes from the Greek terms, *phyton* or "plant" and πλαγκτος ("planktos"), meaning "wanderer" or "drifter". Most phytoplankton are too small to be individually seen with the naked eye, but when present in high numbers, they may appear as a green (or other color) discoloration of the water due to the presence of chlorophyll within their cells

Point Source – A single, identifiable, localized source of pollution that frequently consists of polluting discharges that come out of a pipe or easily located single point such as industrial wastes from a factory.

Succession - The sequential development of plant communities occupying a site over time. For example, a pond is gradually colonized by floating aquatic vegetation. With the infilling of sediments, the water becomes shallower, and rooted plants (reeds and sedges) become established. Eventually the pond fills in, dries out, and shrubs and trees colonize the site.

Total Maximum Daily Load (TMDL) - A TMDL is a value of the maximum amount of a pollutant that a body of water can receive from point and non-point sources while still meeting water quality standards. TMDL's are used extensively by the U.S. EPA in implementing the Clean Water Act through establishment of maximum pollution limits.

Watershed – A watershed is an area of land that water runs over and under on its way to a river, lake or ocean. Watersheds can be defined as small or large land areas. For example, the Mississippi River watershed is very large, encompassing 41% of the continental U.S. Conversely, a watershed can also be very, such as a few acres of land that drain to a local pond.

303(d) List - The 303(d) list refers to Section 303(d) of the Clean Water Act which requires states to identify and list all water bodies in which state water quality standards are not being met. Water bodies listed on this list are considered "impaired" with respect to their ability to support their designated use(s).

APPENDICES

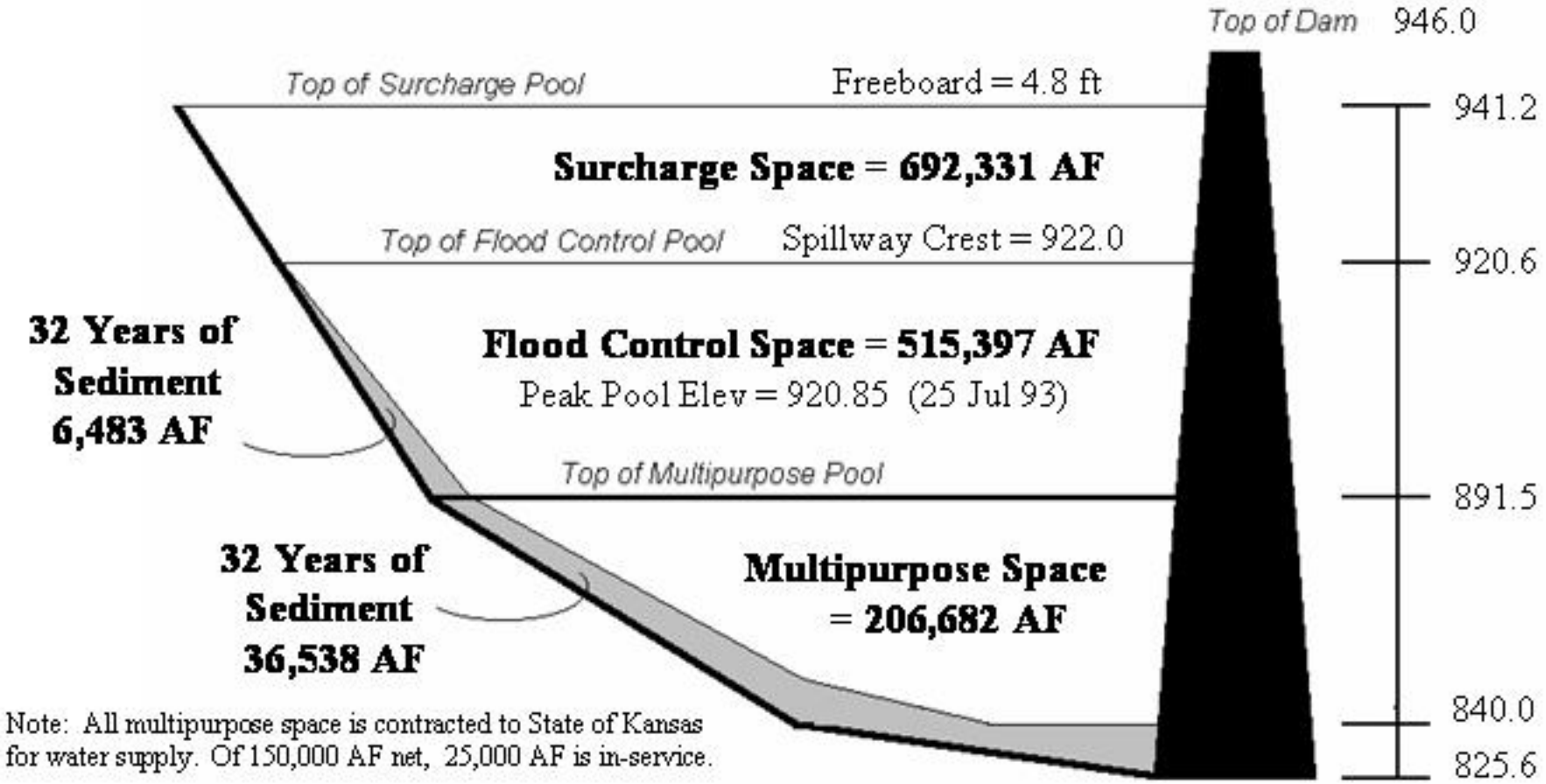
Appendix A

- **Perry Lake Storage Allocations Diagram**
- **Summary Explanation**

Note: the State of Kansas owns 100% of the Multipurpose Space of Perry Lake

Perry Lake Storage Allocations

Lake Storage and Sedimentation Began January 1969
Sediment Survey Last Conducted May 2001



Note: All multipurpose space is contracted to State of Kansas for water supply. Of 150,000 AF net, 25,000 AF is in-service.

Storage Allocation (AF)	1969	Constructed Sediment Reserve	2001	Sediment To Date	Remaining Sed Reserve	Design 2069
Flood Control	521,880	41,880	515,397	6,483	35,397	480,000
Multipurpose	243,220	93,220	206,682	36,538	56,682	150,000

APPENDIX A (continued)

Summary:

The Corps believes that any suggestion that the sediment storage available in Perry Lake will be filled in by 2021 is highly speculative. It is possible that this could occur with an abnormally high incidence of large floods on the scale of 1973 or 1993, but this is not likely. It is also possible that if the recent series of dry years continues then the sediment reserve will not be filled in before the end of this century.

The Corps regularly monitors sediment inflow to Corps lakes. Our last sediment survey using state of the art methods at Perry Lake was completed in May 2001. The analysis of the surveys indicates that about 36,500 AF (1,590 million cubic feet) of sediment had been deposited in the multipurpose pool in the intervening 32 years since the lake first began filling in 1969. This is 39% of the design sediment allocation of 93,200 AF (4,060 million cubic feet) in the multipurpose pool.

This is not significantly greater than anticipated in the 100-year design of the lake. Large Federal lakes in Kansas tend to have higher rates of sedimentation in the early years of the project. As the land encompassing the lake stabilizes and the morphology of the river channel banks immediately upstream of the lake adjusts to the backwater impacts of frequent flood events, the rate of sedimentation decreases over time. Perry Lake was designed with the assumption that the average sediment inflow over the 100-year lifetime would be about 1,350 AF (59 million cubic feet) per year. In the first 10 years of its life, the sediment inflow to Perry Lake averaged 1,760 AF (77 million cubic feet) per year. In the next 10 years, the average rate of inflow declined to 1,470 AF (64 million cubic feet) per year. The 2001 sediment survey is not strictly comparable to earlier surveys, but the analysis points to a recent rate of sediment inflow well below the long term design average of 1,350 AF per year.

By law, the Corps cannot unilaterally initiate basin management projects to reduce sediment inflow to Perry Lake, but we certainly support the State and local landowner efforts to do so. The general public should be reminded that the full water supply allocation of 150,000 AF needed by the State will still be available even after the sediment reserve space is filled in.

Likewise, the Perry Lake flood control pool and its attendant benefits to downstream interests will still be fully effective. The flood control pool also has a sediment allocation of 41,900 AF (1,825 million cubic feet). As of 2001, only 6,500 AF (283 million cubic feet) of this reserve had been filled in, or 16% of the total reserve in the flood control pool. If a substantial portion of the flood control sediment reserve is still available after the multipurpose sediment reserve is filled in it may be possible to reallocate a portion of the flood control sediment reserve to the multipurpose sediment reserve. This would require a pool raise, but it would significantly extend the life of the lake. If this is not possible, then it may be necessary to adjust lake operations, gradually reducing the flood control and multipurpose benefits over time. In any case, we need to reemphasize that the loss of the sediment reserve does not mean the end of the usefulness of the lake.

Source: Steven Fischer, Water Quality Program Manager, U.S. Army Corps of Engineers, January, 2007
Steve Spaulding, U.S. Army Corps of Engineers, January 2007.

APPENDIX B

Threatened and Endangered Species Status

The Endangered Species Act provides protection to animals that are experiencing a decline in population, or nearing extinction. The table below lists species of concern and their federal and state designation(s).

LISTED THREATENED AND ENDANGERED SPECIES			
Species Common Name (Scientific name)	***Threatened (T), Endangered (E), Proposed (P), Candidate (C)***	***Designated Critical Habitat (Y)es/(N)o***	***Listing: Federal (F), State (S)***
Animals, Vertebrate – Fishes			
Chestnut Lamprey (*Ichthyomyzon casteneaus*)	T	Y	S
Flathead Chub (*Platygobio gracilis*)	T	Y	S
Pallid Sturgeon (*Scaphirhynchus albus*)	E/E	Y	F/S
Sicklefin Chub (*Macrhybopsis meeki*)	C/E	Y	F/S
Silver Chub (*Macrhybopsis storeriana*)	E	Y	S
Silverband Shiner (*Notropis shumardi*)	T	Y	S
Sturgeon Chub (*Macrhybopsis gelida*)	C/T	Y	F/S
Topeka Shiner (*Notropis topeka*)	E/T	N	F/S
Western Silvery Minnow (*Hybognathus argyritis*)	T	Y	S
Animals, Vertebrate – Birds			
Bald Eagle (*Haliaeetus leucocephalus*)	T/T	Y	F/S
Eskimo Curlew (*Numenius borealis*)	E/E	N	F/S
Interior Least Tern (*Sterna antillarum athalassos*)	E/E	Y	F/S
Peregrine Falcon (*Falco peregrinus*)	E	N	S
Piping Plover (*Charadrius melodus*)	T/T	Y	F/S
Snowy Plover (*Charadrius alexandrinus*)	T	N	S
Whooping Crane (*Grus Americana*)	E/E	N	F/S
Animals, Vertebrate – Mammals			
Eastern Spotted Skunk (*Spilogale putorius interrupta*)	T	N	S
Animals, Vertebrate – Reptiles			
Redbelly Snake (*Storeria occipitomaculata*)	T	Y	S
Smooth Earth Snake (*Virginia valeria*)	T	Y	S
Animals, Invertebrate – Insects			
American Burying Beetle (*Nicrophorus americanus*)	E/E	N	F/S
Animals, Invertebrate – Snails			
Slender Walker Snail (*Pomatiopsis lapidaria*)	E	Y	S

Source: U.S. Fish and Wildlife Service, Mountain-Prairie Endangered Species List, Kansas (January 2005) http://www.mountain-prairie.fws.gov/endspp/CountyList/KANSAS.htm. The Kansas Department of Wildlife and Parks, Threatened and Endangered Species, http://www.kdwp.state.ks.us/news/other_services/threatened_and_endangered_species. Cited in Natural Resources Conservation Service, "Kansas, Rapid Watershed Assessment, Delaware River Watershed, Hydrologic Unit Code – 10270103", December 2006.

Appendix B (continued)
Species in Need of Conservation

Species Common Name (Scientific Name)	**Critical Habitat (Y)es/(N)o**
Black Tern (*Chlidonias niger*)	N
Cerulean Warbler (*Denroica cerulea*)	N
Southern Bog Lemming (*Synaptomys cooperi*)	N
Henslow's Sparrow (*Ammodramus henslowii*)	N
Short-eared Owl (*Asio flammeus*)	N
Timber Rattlesnake (*Crotalus horridus*)	N
Whip-poor-will (*Camprimulgus vociferus*)	N
Bobolink (*Dolichonyx oryzivorus*)	N
Ferruginous Hawk (*Buteo regalis*)	N
Golden Eagle (*Aquila chrysaetos*)	N
Plains Minnow (*Hybognathus placitus*)	N
Southern Flying Squirrel (*Glaucomys volans*)	N
Blacknose Dace (*Rhinichthys atratulus*)	N
Blue Sucker (*Cycleptus elongatus*)	N
Brassy Minnow (*Hybognathus hankinsoni*)	N
Longbilled Curlew (*Numenius americanus*)	N
River Shiner (*Notropis blennius*)	N
Tadpole Madtom (*Notrus gyrinus*)	N

Source: Kansas Department of Wildlife and Parks website, www.kdwp.state.ks.us/news/other_service/threatened_and_endangered_species.

Endangered Species are any species of wildlife whose continued existence as a viable component of the state's wild fauna is determined to be in jeopardy. The term also includes any species of wildlife determined to be an endangered species pursuant to Public Law 93-205, the Endangered Species Act of 1973 and amendments thereto.

Threatened Species are any species of wildlife which appears likely, within the foreseeable future, to become an endangered species. That term also includes any species of wildlife determined to be a threatened species under Public Law 93-205, the Endangered Species Act of 1973

Species in Need of Conservation are any non-game species deemed to require conservation measures in an attempt to keep the species from becoming a threatened or endangered species

Nongame species: any species of wildlife not legally classified as a game species, furbearer, threatened species, or endangered species by statute or by rule and regulation adopted pursuant to statute

Critical Habitat: specific areas documented as currently providing essential physical and biological features and supporting a self-sustaining population of a listed species; or specific areas not documented as currently supporting a listed species, but determined essential for the listed species by the Secretary of the Dept. of Wildlife and Parks.

APPENDIX C

Stream and Lake Designated Use Tables

Source: Kansas Department of Health & Environment, Bureau of Water, December 2006.

Stream Designated Use Table

Stream Name	AL	CR	DS	FP	GR	IW	IR	LW
Banner Cr	E	b	X					
Barnes Cr	E	b						
Bills Cr	E	b						
Brush Cr	E	C						
Brush Cr	E	b						
Burr Oak Cr	E	C	X					
Catamount Cr	E	C						
Cedar Cr	E	B		X				
Cedar Cr	E	b		X				
Cedar Cr, North	E	C		X				
Cedar Cr, South	E	C		X				
Claywell Cr	E	C	X					
Clear Cr	E	B						
Coal Cr	E	B		X				
Delaware R	E	C	X	X	X	X	X	X
Delaware R	E	C	X	X	X	X	X	X
Delaware R	E	B	X	X	X	X	X	X
Delaware R	E	C	X	X	X	X	X	X
Delaware R	E	B	X	X	X	X	X	X
Delaware R	E	C	X	X	X	X	X	X
Delaware R	E	C	X	X	X	X	X	X
Delaware R	E	C	X	X	X	X	X	X
Delaware R	E	b	X	X	X	X	X	X
Elk Cr	E	C		X				
Elk Cr	E	C		X				
Grasshopper Cr	E	b						
Grasshopper Cr	E	C						
Gregg Cr	E	C		X				
Honey Cr	E	b						
Little Grasshopper Cr	E	b						
Little Slough Cr	E	C						
Little Wild Horse Cr	E	C						
Mission Cr	E	B	X	X	X	X	X	X
Mosquito Cr	E	b						
Muddy Cr	E	C		X				
Muddy Cr	E	b		X				
Nebo Cr	E	b						
Negro Cr	E	b						
Otter Cr	E	b						
Plum Cr	E	b		X				
Rock Cr	E	C	X	X				
Rock Cr	E	C		X				
Slough Cr	E	C	X	X				
Slough Cr	E	C	X	X				
Spring Cr	E	C						
Squaw Cr	E	b						
Straight Cr	E	b		X				
Tick Cr	E	C	X					
Unnamed Stream	E	b						
Walnut Cr	E	C		X				
Wolfley Cr	E	b		X				

AL = Aquatic Life Support
CR = Contact Recreation
DS = Domestic Water Supply
FP = Food Procurement
GR = Groundwater Recharge
IW = Industrial Water Supply
IR = Irrigation Water Supply
LW = Livestock Water Supply

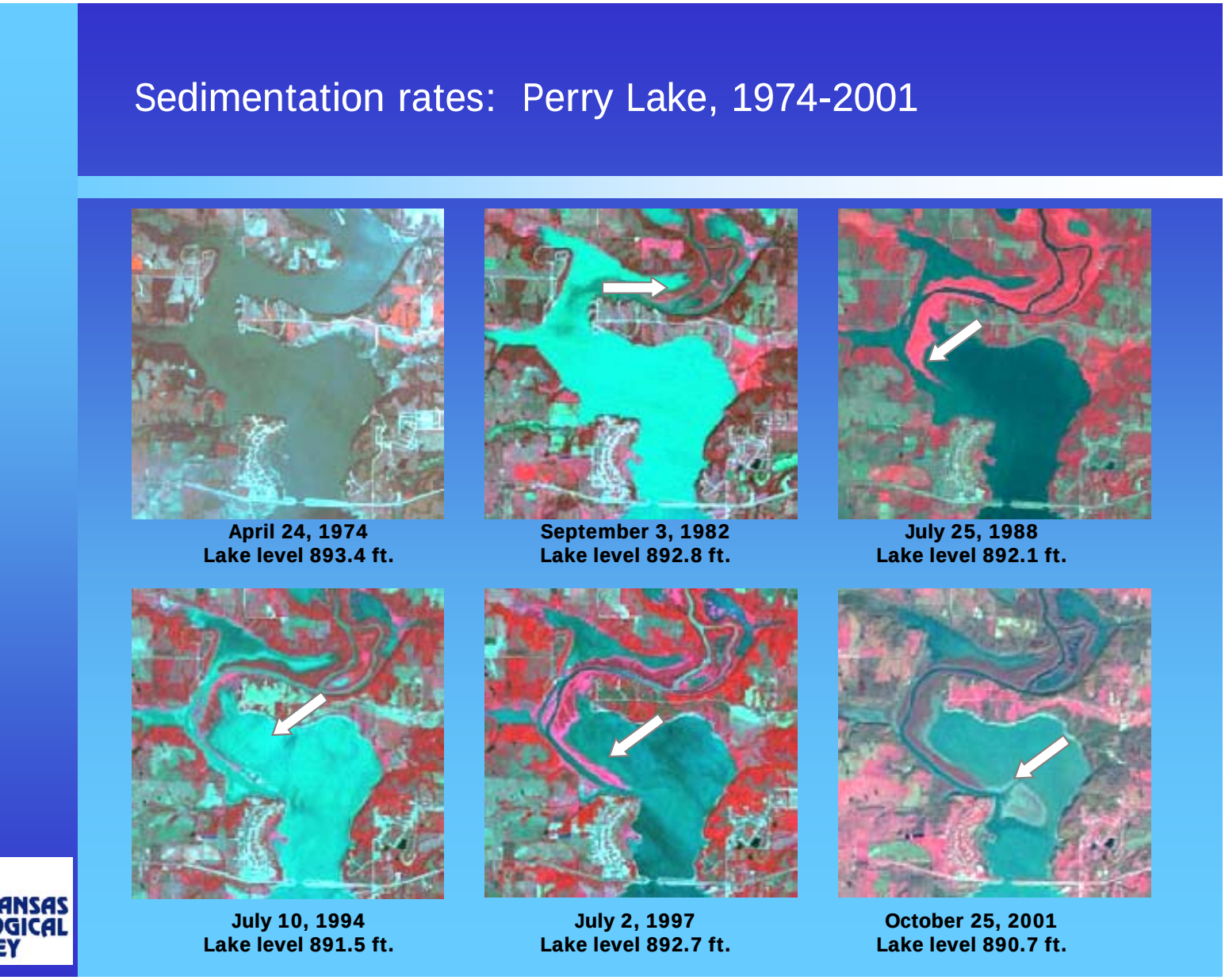
E = Expected Aquatic Life Use Water
S = Special Aquatic Life Use Water
A = Primary contact recreation stream segment is a designated public swimming area
B = Primary contact recreation stream segment is by law or written permission of the landowner open to and accessible by the public
X = Referenced stream segment is assigned the indicated designated use
O = Referenced stream segment does not support the indicated designated use

Lake Designated Use Table

Lake Name	AL	CR	DS	FP	GR	IW	IR	LW
Atchison Co. Park Lake	E	B		X				X
Banner Creek Lake	E	A	X	X		X		
Elkhorn Lake	E	B	O	X		O	O	O
Lake Jayhawk	E	A		X				
Little Lake	E	B	X	X		X	O	O
Mission Lake	E	A	X	X		X		
Muscotah Marsh	E			X				
Nebo SFL	E	B		X				
Oskaloosa Lake	E	A	X	X		X		
Perry Lake	S	A	X	X		X		
Perry W.A. Wetland	E			X				
Prairie Lake	E	A	X	X		X		
Sabetha Watershed Lake (Niehues)	E	B	O	X		O	O	O

APPENDIX D

The following are photos of the upper end of Perry Lake Reservoir, north of KS Hwy 92, illustrating sedimentation rates in this area.



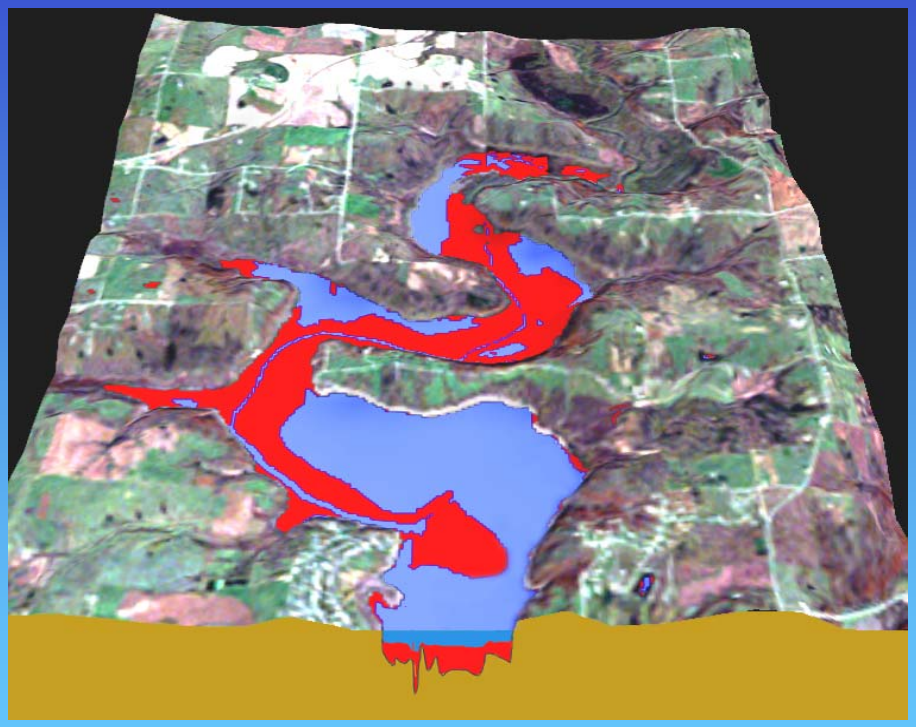
Source: Kansas Biological Survey, Central Plains Center for Bioassessment, May 2006.

APPENDIX D (continued)

Sedimentation volumes

April 24, 1974
Lake level 893.4 ft.

October 25, 2001
Lake level 890.7 ft.



Sediment accumulation, 1974-2001

Estimated 1000+ acres surface area lost
91.5 million cubic yards of sediment

Source: Kansas Biological Survey, Central Plains Center for Bioassessment, May 2006.

APPENDIX E

Source Water Assessment Data for Public Water Supplies in the Delaware River Watershed

Water Supply Name	Susceptibility Rating	Potential Contaminants if Susceptibility moderate to high	Have a Source Water Protection Plan
City of Everest	Low		No
City of Holton	Low		No
Jackson Co. RWD 3	Moderate	Microbiological; inorganic compounds; nitrates; synthetic organic compounds; pesticides; volatile organic compounds	No
Jefferson Co. RWD 10	Low		No
Jefferson Co. RWD 11	Low		No
Jefferson Co. RWD 12	Low		No
Jefferson Co. RWD 3	Low		No
Jefferson Co. RWD 9	Moderate	Microbiological; inorganic compounds; nitrates; synthetic organic compounds; pesticides; volatile organic compounds	No
Lakeside Village Improvement District	Low		No
City of Muscotah	Low to Moderate	Nitrates; synthetic organic compounds; volatile organic compounds	No
Nemaha Co. RWD 4	Low		Yes (2001)

City of Nortonville	Low to Moderate	Microbiological; nitrates; synthetic organic compounds; pesticides; volatile organic compounds	Yes (2005)
City of Ozawkie	Low		No
City of Perry	Moderate	Microbiological; inorganic compounds; nitrates; synthetic organic compounds; pesticides; volatile organic compounds	No
Perry Reservoir Longview Recreational Area	Low to Moderate	Inorganic compounds; synthetic organic compounds; volatile organic compounds	No
City of Valley Falls	Low to Moderate	Eutrophication (phosphorus); sedimentation; synthetic organic compounds; volatile organic compounds	No
City of Wetmore	Low to Moderate	Nitrates; pesticides	No
City of Whiting	Low to Moderate	Microbiological; nitrates	No

Source: KDHE website, Kansas Source Water Assessment Program, Source Water Assessment Reports (www.kdheks.gov/nps/swap/SWreports.html)

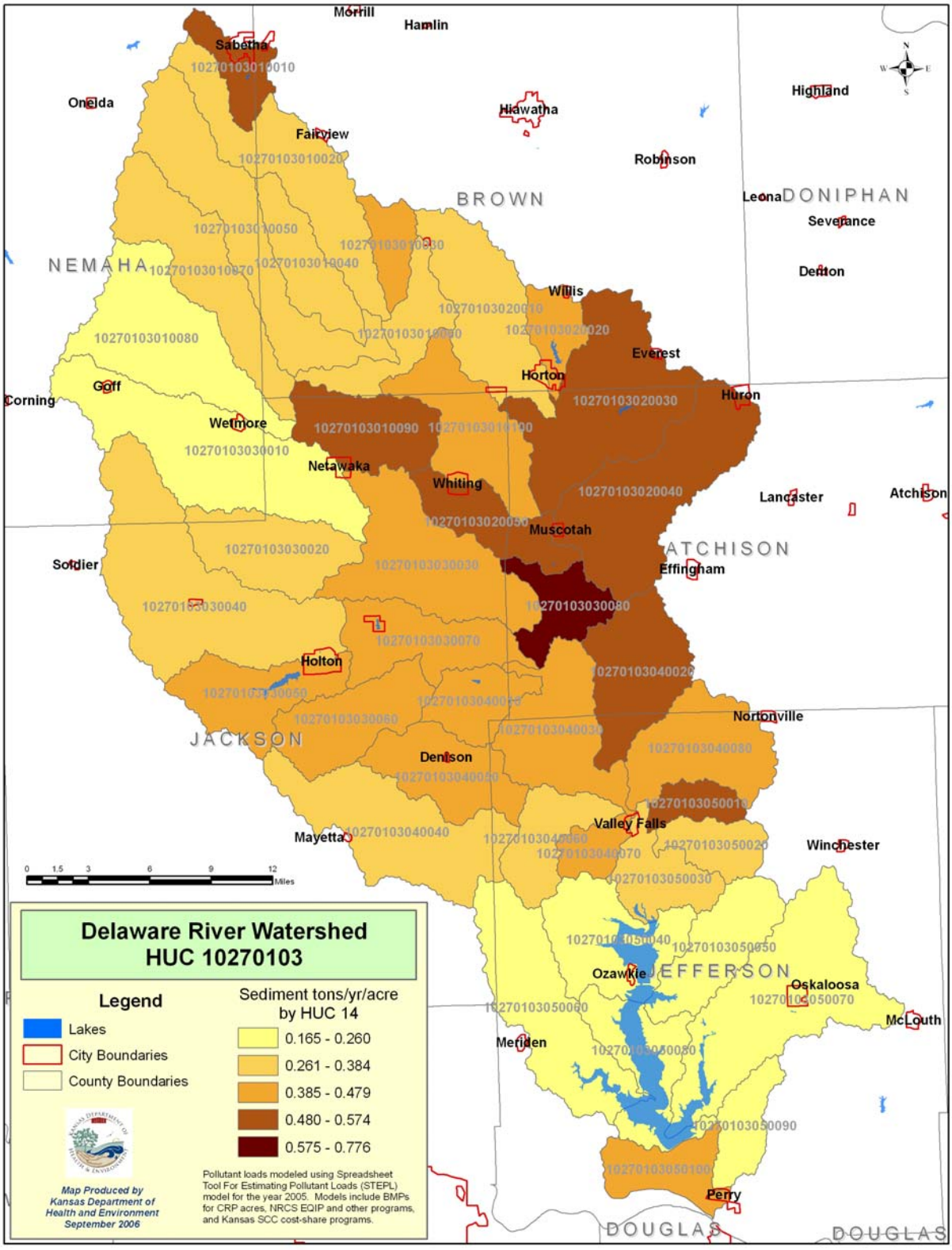
APPENDIX F

STEPL Model Load Maps for:

- **Sedimentation (Total Suspended Solids, TSS)**
- **Nitrogen**
- **Phosphorus**
- **Biological Oxygen Demand (BOD)**

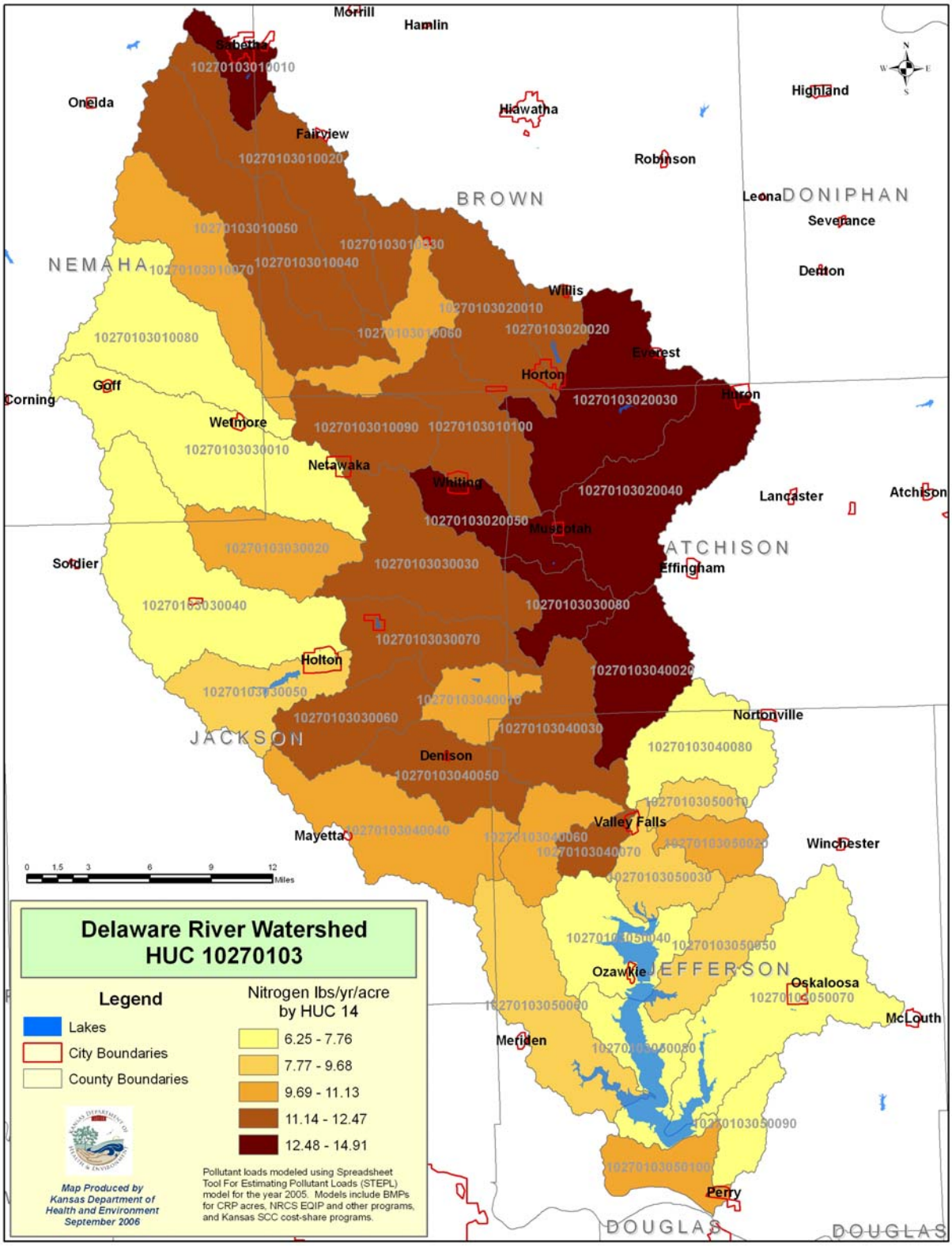
STEPL Model Load Map for <u>Sediment</u>

Delaware River Watershed
HUC 10270103



STEPL Model Load Map for Nitrogen

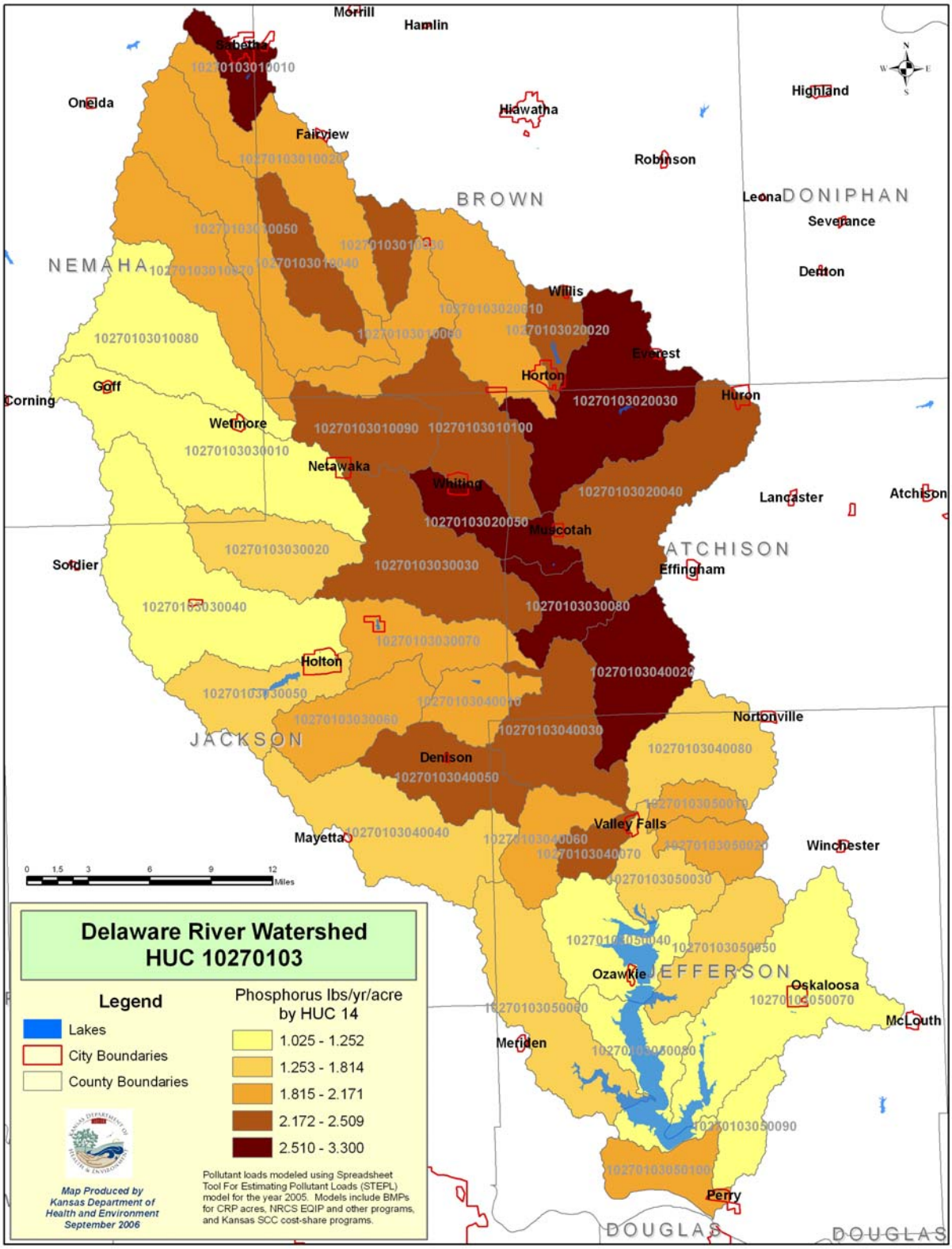
Delaware River Watershed
HUC 10270103



STEPL Model Load Map for <u>Phosphorus</u>

Delaware River Watershed

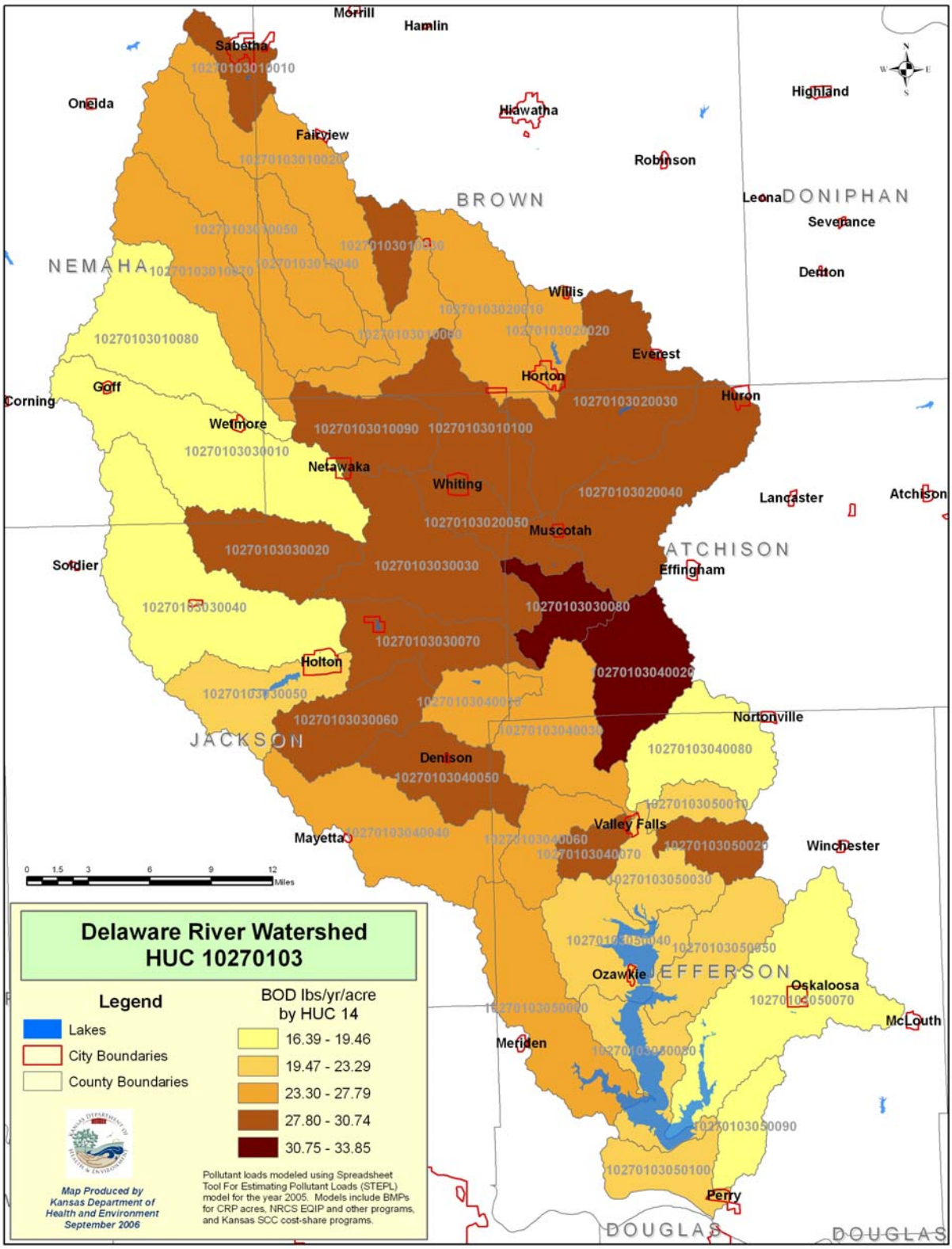
HUC 10270103



STEPL Model Load Map for <u>Biological Oxygen Demand</u>

Delaware River Watershed

HUC 10270103



APPENDIX G

Map of the Delaware River Watershed Showing Active and Inactive River, Lake and Biological Monitoring Sites.

Source: Kansas Department of Health and Environment, Bureau of Water, September 2006.

KDHE Stream, Lake and Biological Monitoring Sites