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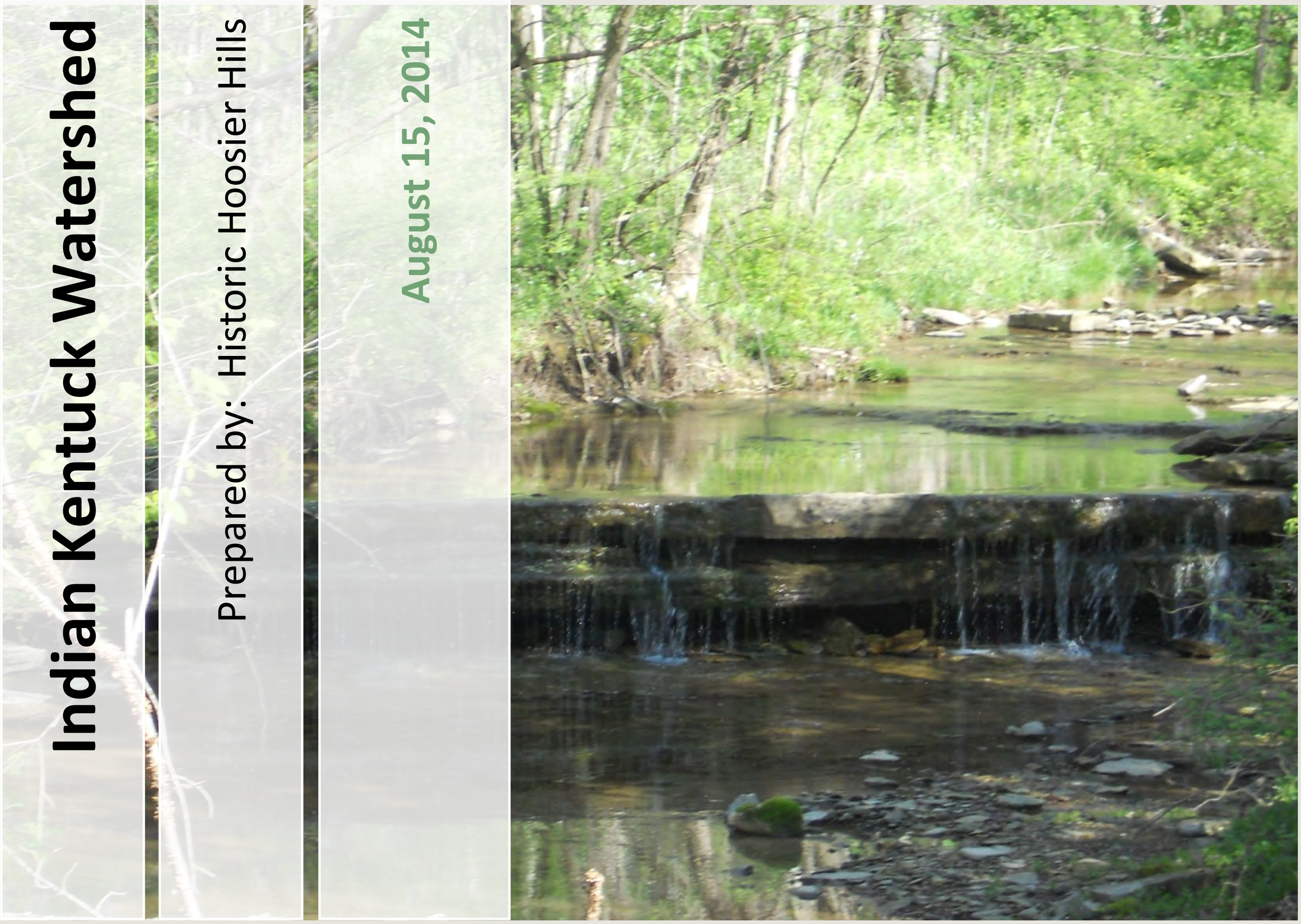

Indian Kentuck Watershed

Prepared by: Historic Hoosier Hills

August 15, 2014

Watershed Management Plan

Indian-Kentuck Watershed

Jefferson, Ripley, & Switzerland Counties, Indiana

Watershed Management Plan

Indian-Kentuck Watershed

Jefferson, Ripley, & Switzerland Counties, Indiana

Prepared for: **Jefferson County Soil & Water Conservation District**
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Acronyms and Abbreviations

AQL Aquatic Life
BMP Best Management Practice
C Celsius
CAFO Concentrated Animal Feeding Operation
CFO Confined Feeding Operation
CFS Cubic Feet per Second
CFU Colony Forming Unit (Bacteria)
CTIC Conservation Tillage Insitute Center
DO Dissolved Oxygen
E.coli Escherichia coli
FCA Fish Consumption Advisory
FEMA Federal Emergency Management Agency
FGDC Federal Geographic Data Committee
GIS Geographic Information System
HEL Highly Erodible Land
HHH Historic Hoosier Hills
HUC Hydrologic Unit Code
IAC Indiana Administrative Code
IBI Index of Biotic Integrity
IDEM Indiana Department of Environmental Management
IDNR Indiana Department of Natural Resources
IGS Indiana Geological Survey
IKW Indian-Kentuck Watershed
ISDH Indiana State Department of Health
LIDAR Light Detection and Ranging
Mg/l Milligrams per Liter
MIBI Macroinvertebrate Index of Biotic Integrity
MS4 Municipal Separate Storm Sewer System
NHD National Hydrography Dataset
NPDES National Pollutant Discharge Elimination System
NPS Nonpoint Source
NRCS Natural Resource Conservation Service
NTU Nephelometric Turbidity Units
OWQ Office of Water Quality (IDEM)
QHEI Qualitative Habitat Evaluation Index
RC&D Resource, Conservation & Development
SWCD Soil and Water Conservation District
TKN Total Kjeldah Nitrogen
TMDL Total Maximum Daily Load
TSS Total Suspended Solid
USDA United States Department of Agriculture
USEPA United States Environmental Protection Agency
USGS United States Geological Survey
UWA Unified Watershed Assessment
WQ Water Quality
WWTP Wastewater Treatment Plant

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ACKNOWLEDGEMENTS

This study was made possible by funding from the Indiana Department of Environmental Management (IDEM) through a 205j grant awarded to the Jefferson County Soil and Water Conservation District (SWCD). Historic Hoosier Hills Resource, Conservation, and Development (RC&D) was contracted by Jefferson SWCD to conduct fieldwork, data collection, report writing and mapping, facilitated public meetings and outreach, and provided project oversight. The Historic Hoosier Hills (HHH) staff responsible for this consisted of Casie Auxier and Terry Stephenson.

The Indian-Kentuck Watershed Steering Committee would like to identify those organizations that have contributed to the success of this project and expresses regret if anyone was overlooked.

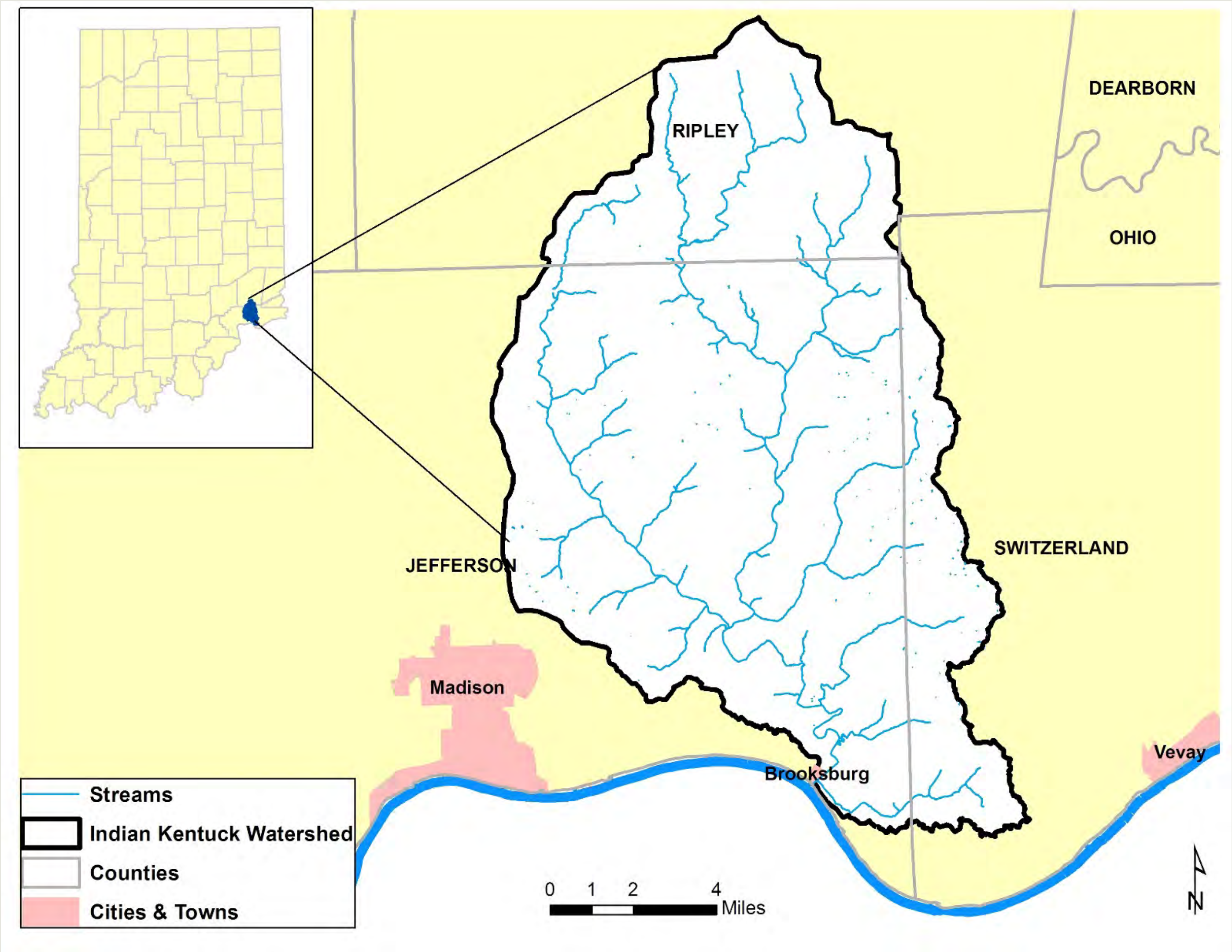
- Indiana Department of Environmental Management
- Jefferson County Soil and Water Conservation District
- Ripley County Soil and Water Conservation District
- Switzerland County Soil and Water Conservation District
- Natural Resources Conservation Service
- Farm Service Agency
- Canaan Community Academy
- Jefferson County Health Department
- Jefferson County Highway Department
- Ripley County Highway Department
- Switzerland County Highway Department

INTRODUCTION

Jefferson County Soil and Water Conservation District (SWCD) contracted Historic Hoosier Hills RC&D to complete field work and write a Watershed Management Plan (WMP) for Indian Kentuck Watershed. The purpose of a WMP is to summarize available data that influence water quality in a watershed and develop a plan for the watershed community to achieve solutions to address water quality concerns. The Indian-Kentuck WMP was funded by an EPA 205j grant administered through the Indiana Department of Environmental Management.

A watershed is an area of land that water flows over and under on its way to a particular body of water. In the United States, watersheds are identified using a hierarchical coding system, Hydrologic Unit Codes (HUC). HUCs are used as a way of cataloguing portions of the landscape according to drainage. Larger watersheds are identified by shorter codes and smaller watersheds are identified by longer codes, designed to be more specific. Indian-Kentuck Watershed is a 10-digit HUC watershed (0514010102) comprised of 97,822 acres, located in Jefferson, Ripley, and Switzerland Counties, Indiana as shown in Figure 1.

Figure 1: Location of Indian-Kentuck Watershed



Initiation of the project

During the spring of 2010 individuals from numerous local, state, and federal conservation organizations met with landowners within the Indian-Kentuck Watershed in Southeast Indiana to answer questions relating to the possibility of initiating a watershed program. The landowner group was aware of similar watershed projects that were being conducted in adjoining areas and knew the potential benefits these projects provided involving water quality.
Initially leaders of this watershed landowner group included members of the Jefferson, Ripley, and Switzerland Soil and Water Conservation Districts. This group had noted that the goals and objectives of surrounding watershed projects tied directly to the goals of the Soil and Water Conservation Districts. In response to this interest the Jefferson Soil & Water Conservation District applied for and was awarded a 205j water quality grant from the Indiana Department of Environmental Management to develop a Watershed Management Plan.

Steering Committee Members

The Jefferson, Ripley, and Switzerland County SWCDs along with Historic Hoosier Hills RC&D personally invited individuals they knew to become a member of the project steering committee. Additional invitations were given to other residents within the watershed to become involved with the project. These invitations were in the form of personal contacts, newsletter invites, and invitations listed in newspaper articles. Steering committee members who participated and gave input on the Indian-Kentuck Management Plan are listed in Figure 2.

Figure 2: Steering Committee Members and Affiliations

Steering Committee Member	Affiliation
Dale Sides	Jefferson County SWCD Supervisor & Landowner
Katie Collier	Switzerland County SWCD District Coordinator
Norbert Schafer	Historic Hoosier Hills Director & Jefferson County Landowner
Travis Robison	Jefferson County Landowner
Brian Day	Jefferson County Landowner
Shawn Scudder	Jefferson County Landowner
Ronald Novak	Jefferson County Landowner
Doug Jackson	Jefferson County Landowner
Lee Rogers	Jefferson County Landowner
Deanna Robison	Jefferson County Landowner
Jerry & Laura Hunter	Jefferson County Landowner
Betsy Sullivan	Jefferson County Landowner
Kim Jolly	Ripley County SWCD District Coordinator & Ripley County Landowner
Steve Thurnall	Ripley County FSA Executive Director & Jefferson County Landowner
Ken Lane	Jefferson County Landowner
Chris Stearns	Jefferson & Ripley Counties Landowner
Tim Schwipps	Jefferson & Ripley Counties NRCS District Conservationist
Vickie Smith	Ripley County Landowner

The goals of the Steering Committee are to:

1. Develop watershed management plan by:
    a. Develop mission statement and vision statement;
    b. Define pollutant sources and causes, area of protection and problem statements;
    c. Set goals and develop solutions based on measurable indicators from water testing results of watershed streams;
    d. Create an action plan to set priorities, timeframes, and task assignments;
    e. Evaluate the plan by interests generated through the watershed group and data obtained though monitoring.
2. Attend scheduled IKW Steering Committee meetings;
3. Attend and support watershed project activities;
4. Promote and share watershed plan information with the community.

Stakeholder Concerns

A public meeting was held on May 31, 2012, at the school in Canaan. There were 25 in attendance and the initial portion of the meeting involved introduction of the watershed concept and the Indian-Kentuck project. Details of the watershed were explained which included, boundaries of the watershed, land uses, and streams identified on IDEM's 303(d) list of impaired waterbodies due to biotic impairment and elevated E.coli counts.

Stakeholder concerns about the watershed were the main reason for the meeting and landowners participated freely. The session was facilitated by HHH personnel and topics were arranged and identified with resource categories used by the Natural Resource Conservation Service during conservation planning with landowners. Additional concerns were collected through a survey (Region 5 EPA Social Indicator) which was sent to 395 watershed residents with 101 responding. Some individuals did not respond to all questions on the survey. The following list represents comments from landowners.

STAKEHOLDER CONCERNS:

- SOIL
    - Excessive gully erosion in cropland and pastures
    - Too much conventional tillage of cropland
    - Lack of grade stabilization structures to control runoff from cropland
    - Stream bank erosion
    - Need for soils education involving, compaction, cover crops and nitrogen fixation issues
    - Sinkholes in crop and pasture fields
    - Sedimentation from erosion caused by overgrazing

- WATER
    - Livestock in the creek
    - E.coli within the streams – 303(d) source
    - Pollution from failing septic systems and lack of septic systems in some cases
    - Dumping in the stream
    - Permitting to have access to the stream to do maintenance with equipment.
    - Blockage of the stream due to rocks and trees

- AIR
    - Application of chemicals

- PLANT
  - Invasive species in woodland and cropland
  - Low quality plant species in pastures
  - Need for more timber stand improvement
  - Need for cover crops on cropland
  - Using biological methods to control stream bank erosion

- ANIMALS
  - Fencing of livestock from sensitive areas
  - Need for education on harming wildlife
  - Overpopulation of deer within the watershed
  - Dumping remains of wildlife by hunters

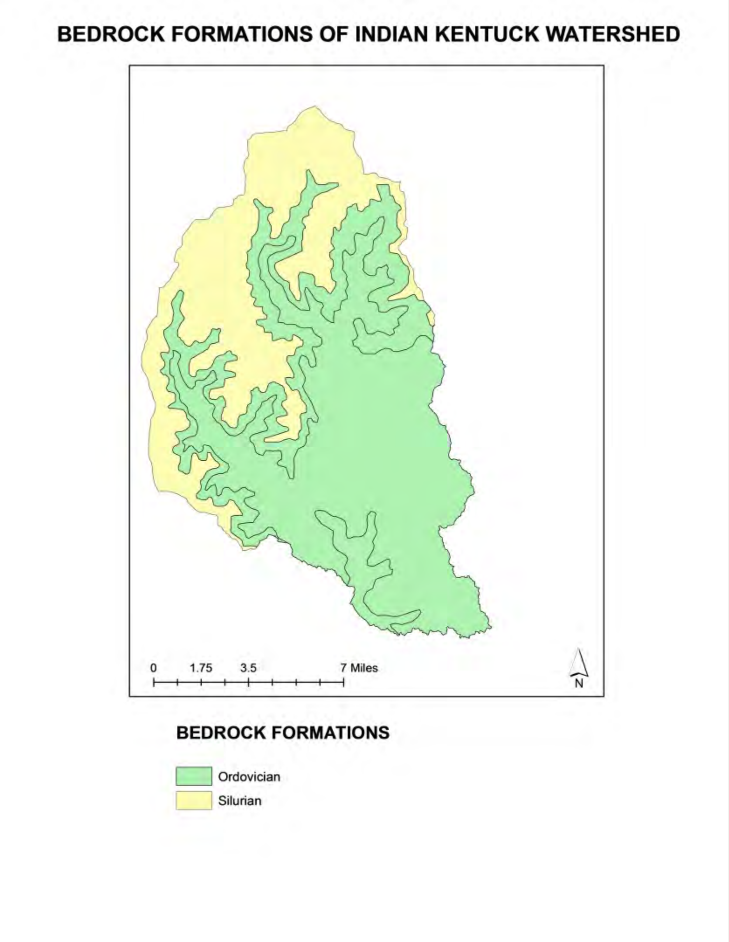
- HUMAN
  - Sediment filling pools for fish
  - No wake zone not being enforced
  - ATV’s in creek

Geology & Topography

Geology of the watershed in the eastern two-thirds of the area consists primarily of limestone and shale deposited during the Ordovician age 500 million years ago. Geology in the north-western one-third of the watershed consists of limestone and dolomite of the Silurian age 350 million years ago. Both geologic formations lend themselves to dendritic drainage patterns with the effect being smaller upland streams draining into the main branch of Indian-Kentuck as shown in Figure 3.

Limestone in the watershed often interacts with underground water and dissolves the limestone to form karst topography or sinkholes. Sinkholes within the Indian-Kentuck Watershed are scattered throughout the watershed and are relatively small in size but do provide a direct channel to groundwater and potential contamination. See Figure 4 for locations.

Figure 3: Bedrock Formation of Indian-Kentuck Watershed



The bedrock stratum of the watershed area generally does not lend itself to wells for drinking water. However there are wells scattered throughout the area that provide water for domestic use although successful drilling is inconsistent. Much of the area is tied to a municipal water system that is supplied from deep wells along the Ohio River. Other sources of drinking water come from reservoirs that are tied to municipal water systems.

The topography of the Indian-Kentuck Watershed varies greatly. The northern one third of the watershed contains level to moderately sloping topography with a few areas of steeper slopes. The lower two-thirds of the watershed contain topography with narrow moderately sloping ridge tops but the majority is steeply sloping with small alluvial areas extending from the hillside toe slope to the creek.

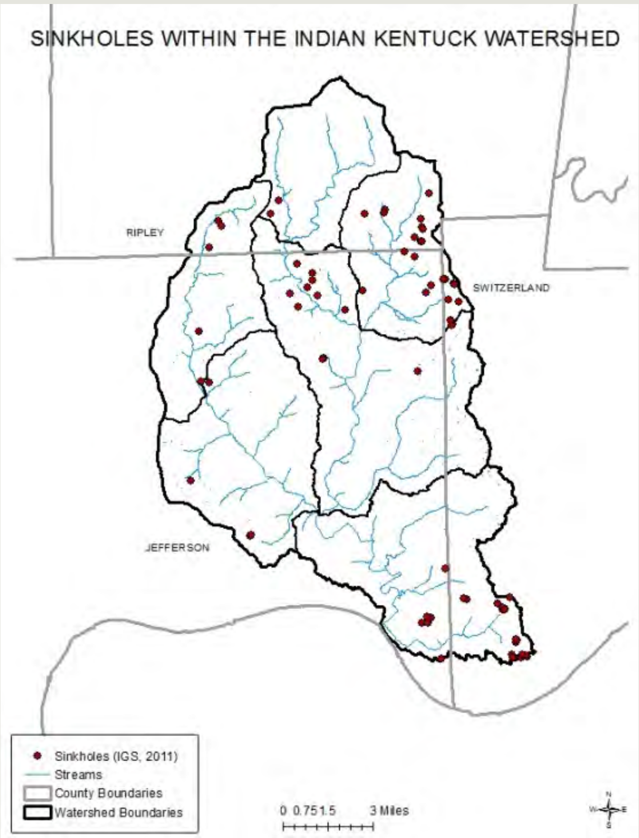


Figure 4: Sinkholes within Indian-Kentuck Watershed

Hydrology

Watersheds are divided into units, called Hydrologic Units, by the United States Geological Survey, and are coded into Hydrologic Unit Codes (HUC). Every watershed in the nation whether large or small has a unique HUC.

The Indian-Kentuck Watershed project is identified as a 10 digit HUC (0514010102) and encompasses an area of 97,822 acres. Within this 10 digit HUC are smaller watershed units identified with 12 digit HUC's as shown in Figure 5

Below in Figure 6 is the breakdown of HUC's for the Ohio River Basin. As shown the largest hydrologic unit area has a two digit code, while its sub units (units that comprise Indian-Kentuck Watershed) have 12 digit codes (HUC) shown in Figure 5.

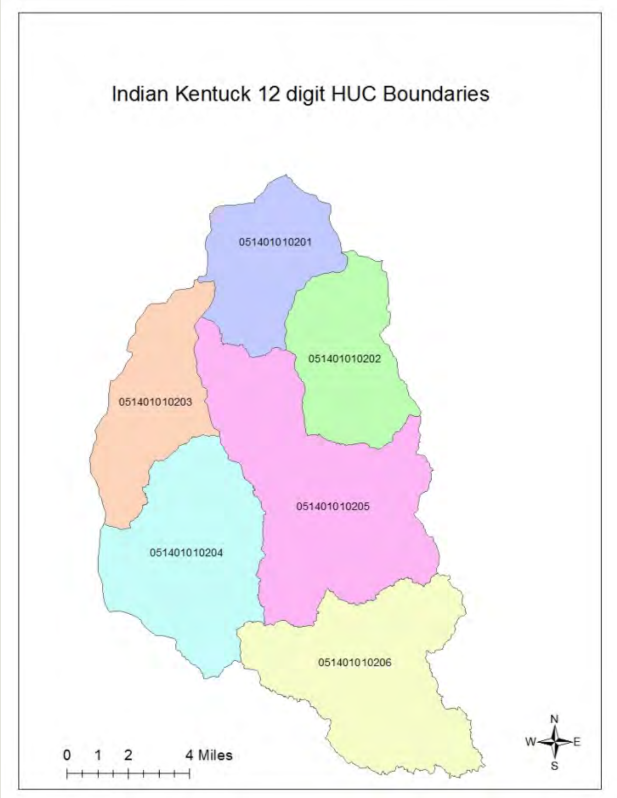


Figure 5: Indian-Kentuck 12 digit HUC Boundaries

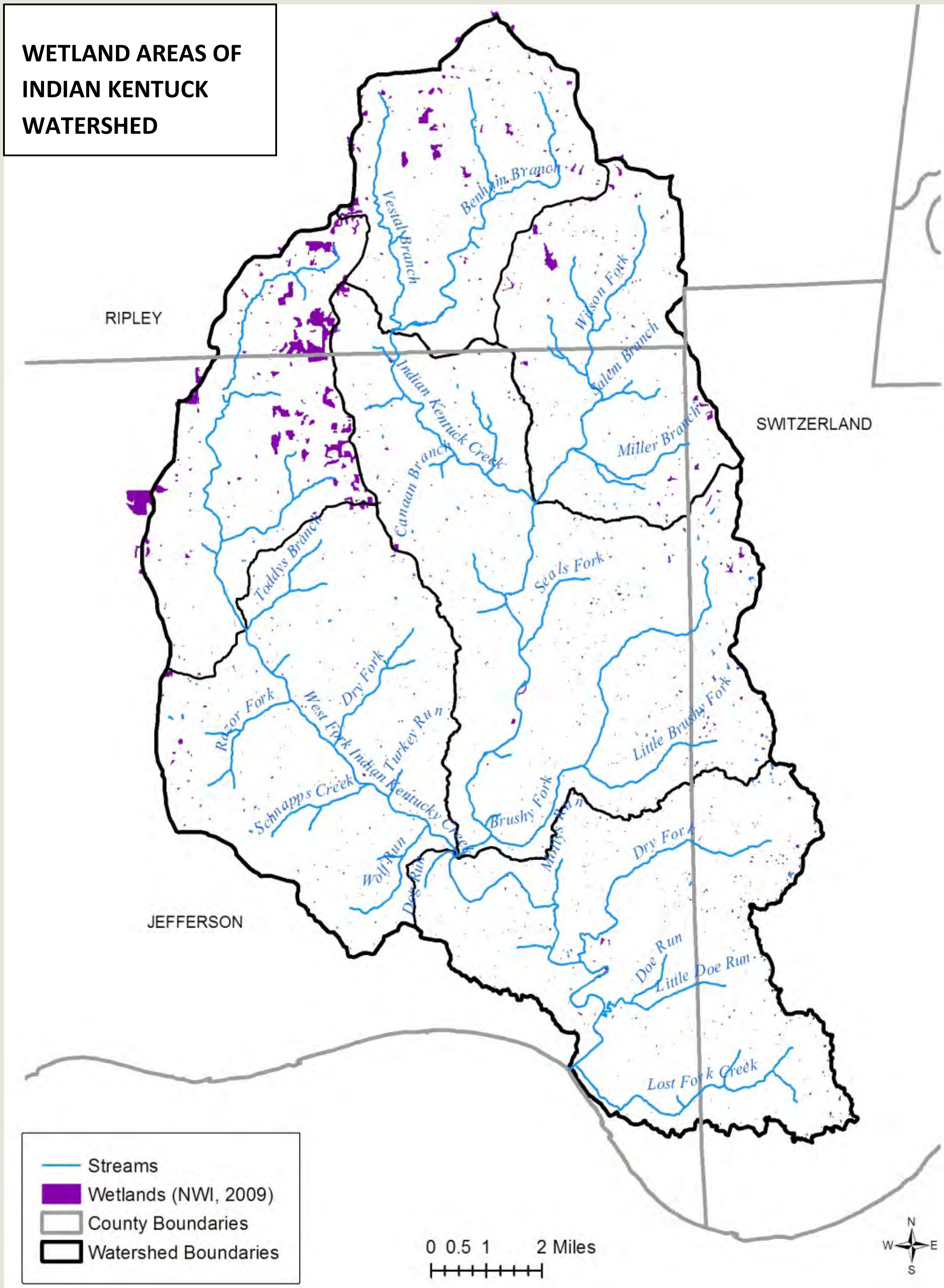
Figure 6: HUC's for the Ohio River Basin

UNIT CATEGORY	HUC	NAME	SIZE (acres)
Regional code	2-digit HUC (05)	Ohio River Basin	104,235,187
Sub regional code	4 digit HUC (0514)	Lower Ohio	8,113,970
Accounting unit code	6 digit HUC (051401)	Lower Ohio - Salt Basin	3,915,878
Cataloging unit code	8 digit HUC (05140101)	Silver - Little Kentucky Basin	826,168
Watershed unit code	10 digit HUC (0514010102)	Indian-Kentuck Basin	97,822
Sub watershed unit code	12 digit HUC's		
	051401010201	Vestal Branch	10,988
	051401010202	Wilson Fork	11,751
	050401010203	Headwaters West Fork	11,426
	050401010204	West Fork	18,019
	050401010205	Brushy Fork	25,830
	050401010206	Doe Run	19,780

Streams of the Indian-Kentuck Watershed are used primarily by landowners for livestock watering. Public uses of streams within the watershed include recreation involving fishing, swimming, and boating at the lower end of the main channel. Length of the main channel and its major tributaries total approximately 42 miles. See Figure 7 for location of all streams in the Indian-Kentuck Watershed. There are no public lakes, legal drains, or ditches located within the Indian Kentuck Watershed boundary.

Wetlands

A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. Primarily, the factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation that is adapted to its unique soil conditions. Wetlands consist primarily of hydric soil, which supports aquatic plants.



Wetlands play a number of roles in the environment, principally water purification, flood control, and shoreline stability. Wetlands are also considered the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal life.

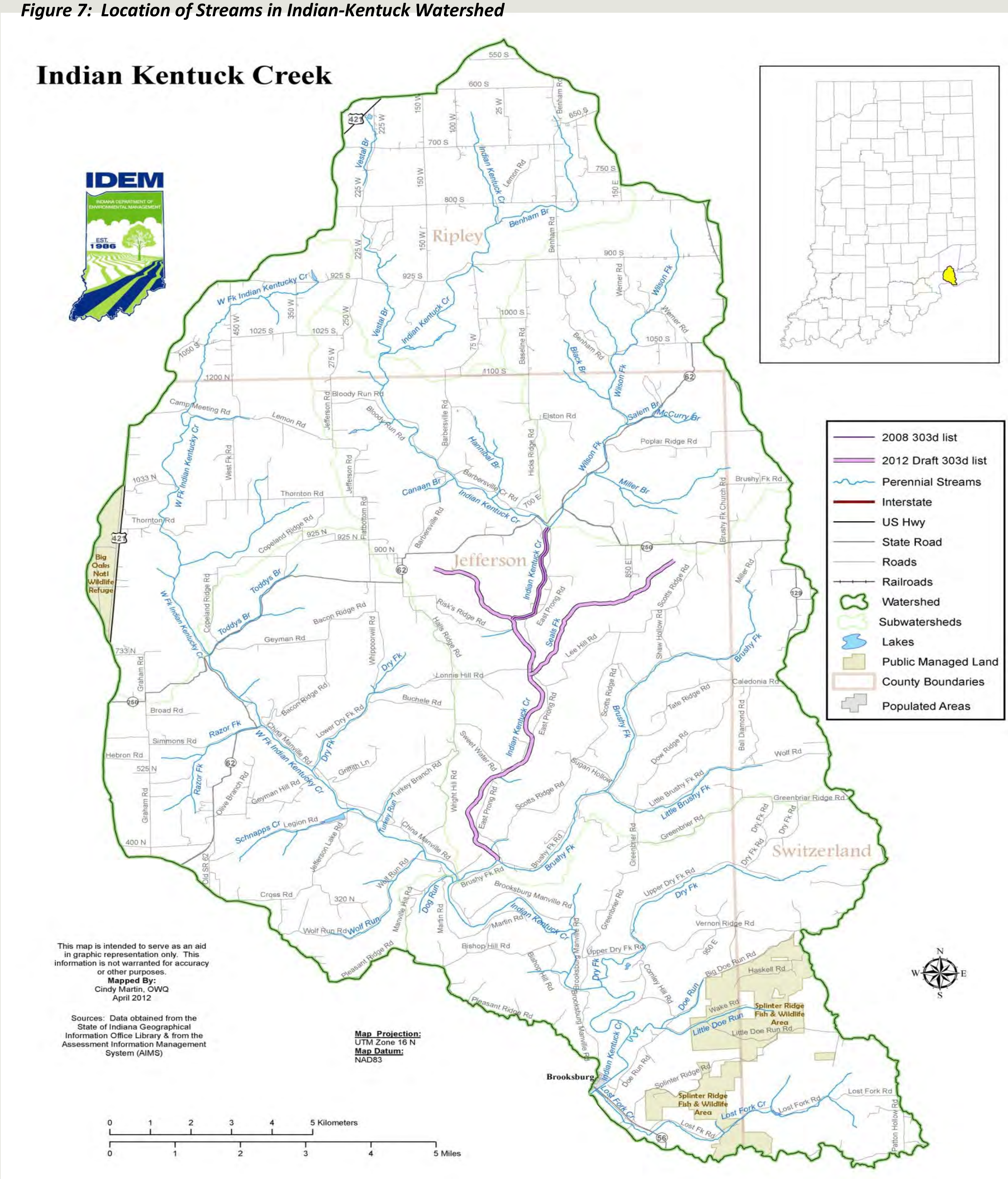
Wetland areas within the Indian Kentuck watershed are small in size and typically are flooded during spring and winter months and dry at the surface during summer months.

Total acreage of wetland area within the Indian Kentuck Watershed is 1714 acres and occurs primarily in the subunits of Vestal Branch, Wilson Fork, and Headwaters West Fork.

Lakes within the Indian Kentuck Watershed are small privately owned with an average size of 0.26 acres. The total number of lake acres is estimated at 163 acres which entail an estimated 163 small lakes.

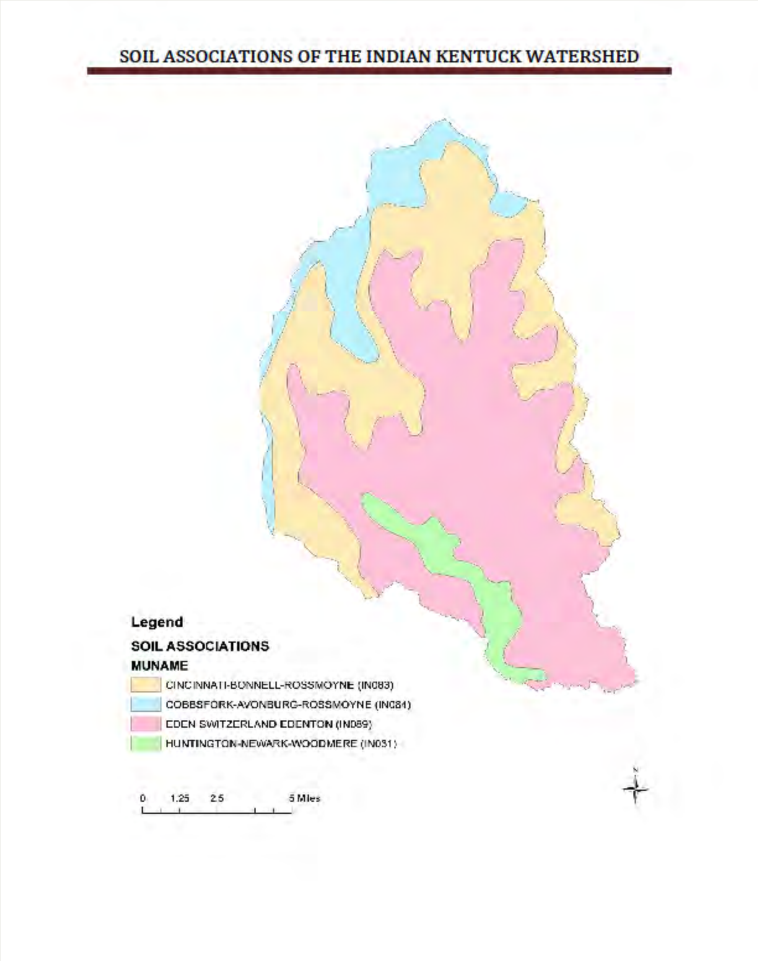
There are currently no hydrologic modifications occurring or planned within the watershed.

Figure 7: Location of Streams in Indian-Kentuck Watershed



Soils

Figure 8: Soil Associations of the Indian-Kentuck Watershed



The watershed is underlain with Ordovician-age shale and limestone over the southeastern 2/3 of the watershed with the remaining northwestern 1/3 being underlain with limestone of the Silurian age. This results in several different soil types within the watershed. There are 4 different soil associations within the watershed which include the soils of Avonburg, Cincinnati, Cobbsfork, Eden, and Rossmoyne soil types as shown in Figure 8.

The Cincinnati, Bonnell and Rossmoyne soil association is comprised of deep, nearly level to steep, well drained and moderately well drained, medium textured soils formed in loess and underlying glacial till. These soils occur on upland side slopes and ridge-tops and are used for row-cropping on the level areas and as hayland – pasture and woodland on the steeper portions.

The Eden, Carmel and Switzerland soil association is made up of moderately deep to deep and well drained, with slopes ranging from moderately sloping to very steep. These soils are primarily used for pasture and woodlands. For building sites, shrink-swell and slippage of these soils are a concern.

To a lesser extent the Cobbsfork and Avonburg soil association is also found within the watershed. These soils are deep and somewhat poorly to poorly drained. They have a seasonal high water table and have 0 to 2 percent slopes. These soils are primarily used for cropland.

The Huntington, Newark, and Woodmere soil association are found in the alluvial areas of the watershed. These soils are deep and well to somewhat poorly drained. These soils are subject to flooding and are used primarily for cropland.

Soils within the Indian-Kentuck Watershed have severe limitations for septic tank absorption fields due to wetness and/or slow percolation. Failing septic systems are identified as a concern by stakeholders and in many cases soil incompatibility may be the reason for septic failure.

Most soils within the watershed are susceptible to erosion if left unprotected due to lack of residue on land used for row cropping and overgrazing that often occurs on pastureland. Sediment filling pools for fish was also identified as a concern. These issues have been identified as watershed concerns by landowners. A general soils map for the Indian-Kentuck Creek Watershed is shown above with the 4 distinct soil associations identified.

Highly Erodible Soil (HES)

In the NRCS field office tech guide of 1992, Section II-iii-A-(5), describes highly erodible soils as follows. "The Food Security Act of 1985 required that soil survey map units be separated into three categories on the basis of potential erodibility due to wind erosion and sheet and rill erosion. A Highly Erodible Soil Map Unit list designates the category assigned to each map unit. It has been determined that no map units are highly erodible because of only wind erosion in Indiana.

The equation for determining potential erodibility from sheet and rill erosion is A=RK(LS)

(A) is the amount of soil loss in tons per acres, R is the rainfall factor, K is the soil erodibility factor, and L and S are the slope length and steepness factors, respectively, T represents the tolerable soil loss in tons per acre determined by the NRCS and while not included in the USLE it is important for USLE factor A to equal T to sustain soil productivity.

"A map unit is designated highly erodible (class 1) if the value (A) obtained from the RK(LS) equation is equal to or greater than 8 when the minimum slope length and minimum slope percent are used."

"A map unit is designated potentially highly erodible (class 2) if the values obtained from the RK(LS) equation is less than 8 when the minimum slope length and minimum slope percent are used.

A map unit is designated not highly erodible (class 3) if the values obtained from the RK(LS) equation is less than 8 when the maximum slope length and maximum slope percent are used."

"The minimum and maximum slope percent are obtained from the map unit name, i.e. Rossmoyne silt loam, 2 to 6 percent slopes. Two is the minimum value and 6 is the maximum value. The minimum and maximum slope lengths were determined by soil scientists during field mapping for the Indiana Accelerated Soil Survey Program.

Moreover, highly erodible land is identified by two factors according to NRCS; slope and feet. The distance measured to determine the slope also is used to define the steepness of the soil type.

The soil type is marked with a map symbol to describe the steepness. This scientific data is used by NRCS for application purposes. Visit NRCS online or contact your local NRCS Field Office, District Conservationist for more information. See Figure 9 for HEL areas within the Indian-Kentuck Watershed.

Below Figure 10 designates Highly Erodible Land (HEL), Potentially Highly Erodible Land (PHEL), and Non-Highly Erodible Land (NHEL)

Figure 10: Erodible Land

	HEL	PHEL	NHEL	Water	Total
Jefferson	41132	13474	10812	109	65527
Ripley	7666	4939	7403	92	20100
Switzerland	9529	1670	921	55	12175
Total	**58327**	**20083**	**19136**	256	97802
%	**59.6**	**20.5**	**19.6**	0.3	100.0

HEL + PHEL	78410
HEL + PHEL (%)	80.2

Septic Suitability

There are two very important considerations when installing a septic system: proper soil type and adequate separation distance from water tables and/or impermeable soil. The best soils for a leach field are those that are deep, well-drained, and strong to moderate structured soils such as silt loam or loam soil types. As indicated in Figure 11 most soil associations found in the Indian Kentuck watershed are not suitable for septic tank absorption fields. Placing septic systems in soils unsuitable for leach fields have a high chance of malfunctioning, leading to the contamination of both land and water. Although soils within the watershed are not suited for septic fields there are no areas that have sewers within the watershed. The communities of the Indian Kentuck Watershed are small in size with residential and business dwellings on septic systems. Ratings for septic system suitability within the watershed are :

- Very limited – 96.4% 94,261 acres
- Somewhat limited – 3.3% 3,255.7 acres

This makes a total of very limited and somewhat limited acreage ratings within the watershed of 99.7% or 97,517.6 acres.

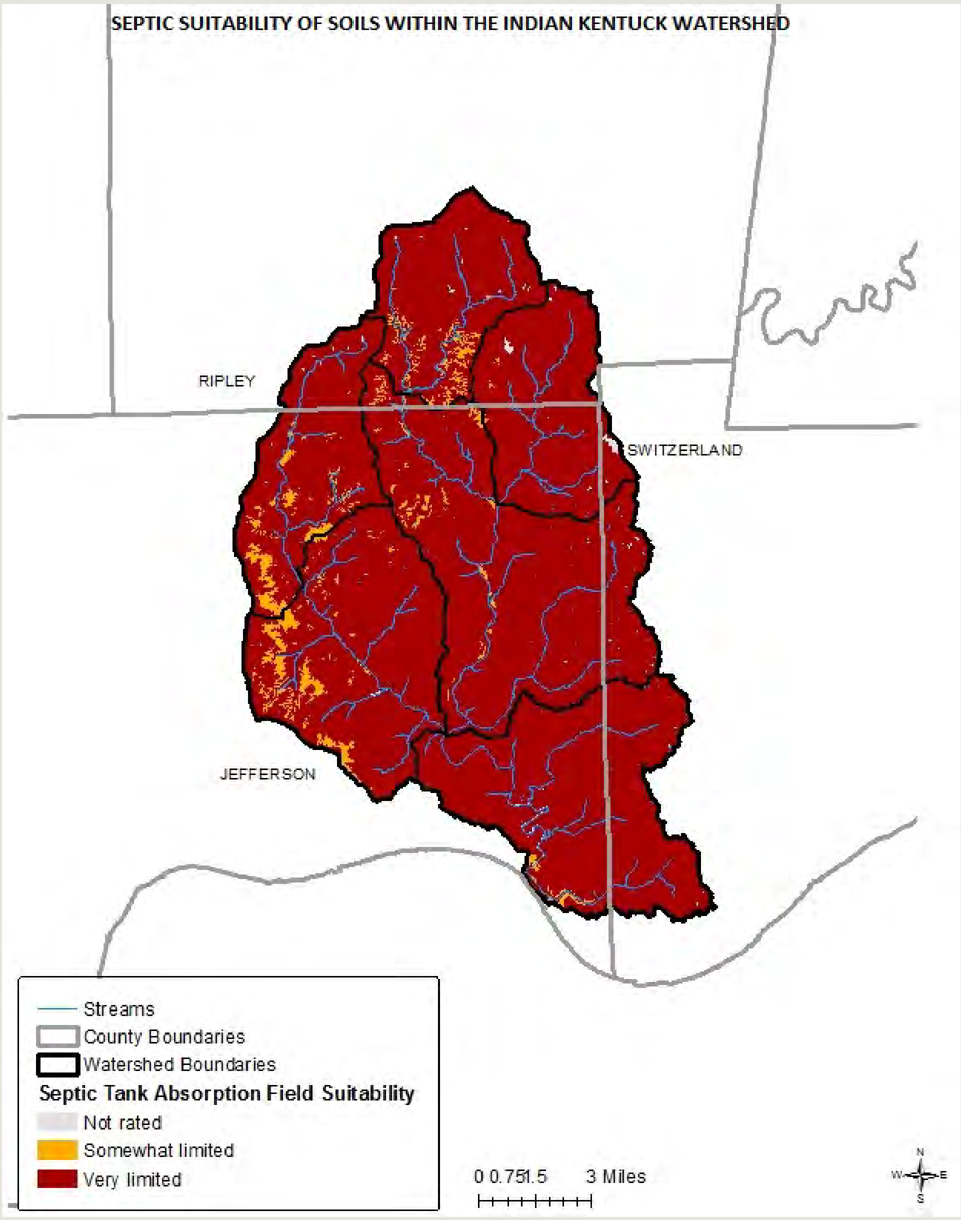


Figure 11: Septic Suitability of Soils within the Indian-Kentuck Watershed

HYDRIC SOILS

Hydric soils are those soils that are sufficiently wet in the upper part to develop anaerobic conditions during the growing season. Hydric soils are commonly associated with wetland areas and are strongly influenced by the presence of water. A soil is considered hydric if it has been flooded or saturated with water long enough to become anaerobic, meaning there is no oxygen present. Hydric soils, while posing a significant problem when farmed, also are quite beneficial as they supply many ecological benefits and can help prevent polluted runoff from reaching open water.

Figure 12 indicates areas within the Indian Kentuck watershed that meet the hydric soil criteria which total 6.5% (6354.5 acs) of the watershed .

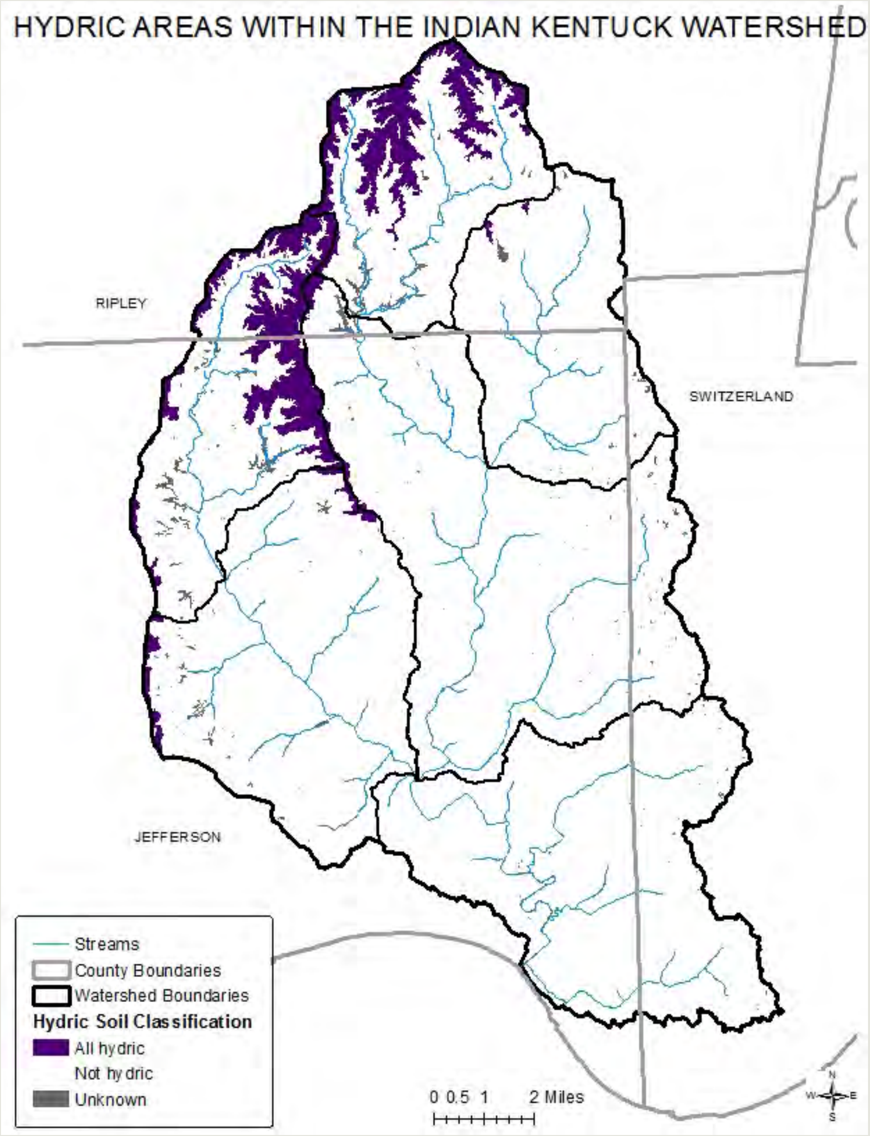


Figure 12: Hydric Areas within the Indian-Kentuck Watershed

Land Use in the Watershed

As shown in Figure 13 forest dominates the Indian-Kentuck Watershed landscape comprising 65% of the area. Other major land uses include cultivated cropland encompassing 15% and pasture and hay covering 11% of the watershed. Many of the stakeholders concerns relate directly to these land uses (see Figure 14). Stakeholders indicated they felt there is too much conventional tillage occurring within the watershed which is leading to excessive erosion. Tillage transect data from CTIC indicated that Jefferson County had conventional and mulch tillage of 55% in corn and 29% in soybeans. Ripley County had conventional and mulch tillage of 63% in corn and 45% in soybeans. Switzerland County had conventional and mulch tillage of 22% in corn and 4% in soybeans. Stakeholders also felt that conservation tillage and cover crops could help eliminate erosion were on crop fields within the watershed.

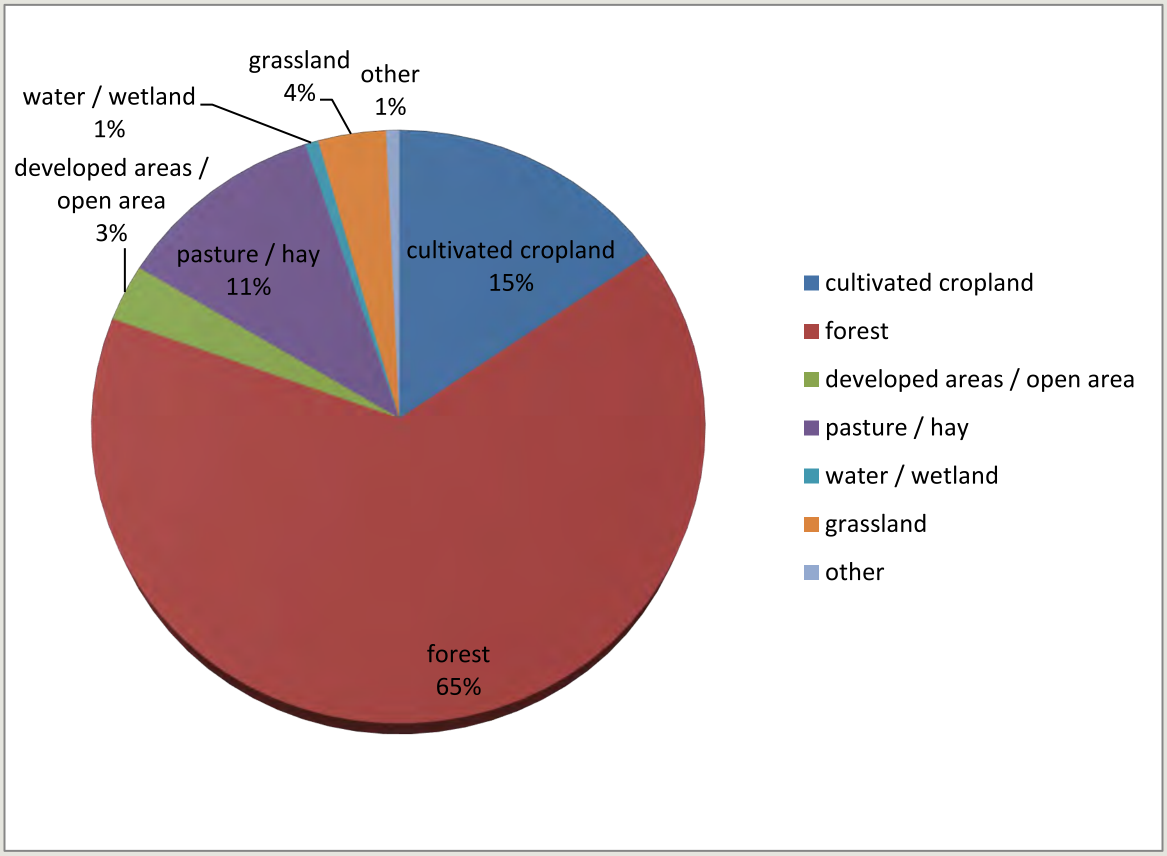


Figure 13: Landuse Percentage in the Indian-Kentuck Watershed

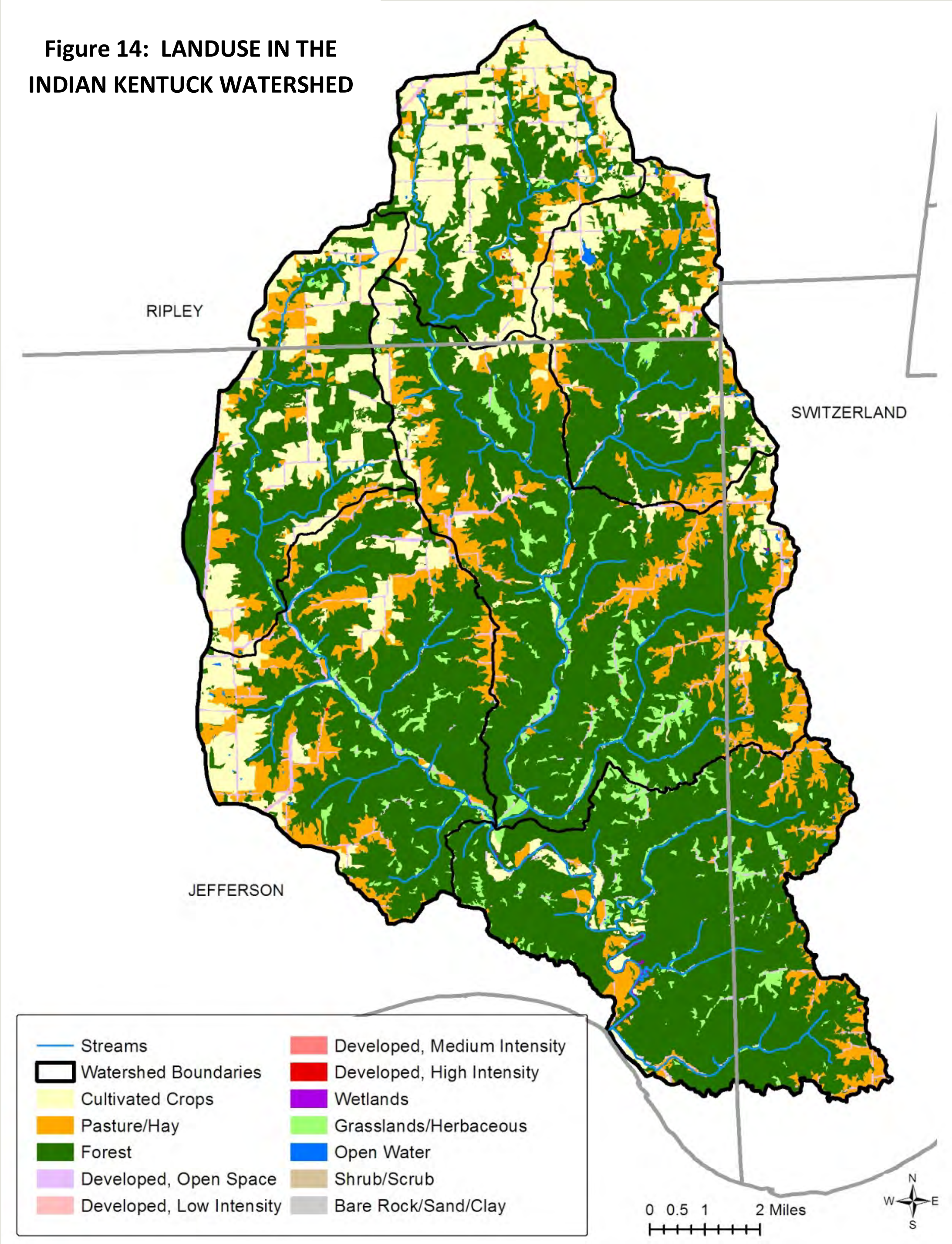
Pasture and hayland acreage within the watershed has need for improvement according to stakeholders. Much of this acreage is being overgrazed and has a low quality of plant species which intensifies the overgrazing problem. Stakeholders also recognized that livestock within the watershed have access to sensitive areas and streams. There is little use of fertilizer on suburban land since most of the watershed is rural in nature. There may be situations where the wildlife (especially deer) population contribute to waste material into streams. There are many “Hobby Farms” that have only a few head of livestock but often have small pastures that are overgrazed.

Forest is the main land use within the watershed comprising 65 percent of the area. During public meetings stakeholders have identified the need for eliminating livestock from wooded areas and the need for timber stand improvement. The use of BMP’s to address stakeholder concerns will improve water quality within the area by reducing sedimentation and nutrient loading.

Towns within the watershed include Benham, Brooksburg, Byrantsburg Canaan, China, Cross Plains, and Manville. These towns are unincorporated under county jurisdiction. There are planning efforts to develop an updated comprehensive plan in Jefferson County and Ripley County has a current comprehensive plan in place. These plans address issues such as zoning and criteria required for residential and agricultural uses. Many of the strategic and comprehensive planning efforts by local governments include minimum lot sizes for residential homes and identifying an alternative septic field on lots before issuing a building permit.

Currently IDEM has identified four underground storage tanks classified as leaking (LUST) within the watershed. All four tanks are located in the Vestal Branch (201) subunit.

Figure 14: LANDUSE IN THE INDIAN KENTUCK WATERSHED



As mentioned above the nature of the Indian Kentuck Watershed consist of a landscape where the topography is primarily rolling to steep with soils that have limitations due to slope, texture, and a limiting bedrock layer in many cases. This presents many challenges in using the land for agricultural use such as row crops or grazing.

This is also challenging for building due to the majority of the watershed having soils that have severe limitations for septics. Although there is new technology available that is helping to alleviate this problem. Some of this new technology was presented by local health officials at an Indian Kentuck workshop held in February 2014.

The plan of the Indian Kentuck Steering Committee is to continue to present workshops that will assist landusers in meeting challenges they face involving agricultural or residential use of the land and water resources of the Indian Kentuck Watershed.

Threatened & Endangered Species

The Indiana Natural Heritage Data Center, part of the Indiana Department of Natural Resources, Division of Nature Preserves, maintains a database documenting the presence of endangered or threatened species; high quality natural communities; and natural areas in Indiana. The database originated as a tool to document the presence of special species and significant natural areas and to assist with management of said species and areas where high quality ecosystems are present.

The database is populated using individual observations, which serve as historical documentation, or as sightings occur; no systematic surveys occur to maintain the database.

The state of Indiana uses the following definitions to list species:

- Threatened: Any species likely to become endangered within the foreseeable future. This includes all species classified as threatened by the federal government which occur in Indiana. Plants currently known to occur on six to ten sites in the state are considered threatened.
- Endangered: Any species whose prospects for survival or recruitment within the state are in immediate jeopardy and are in danger of disappearing from the state. This includes all species classified as endangered by the federal government which occur in Indiana. Plants currently known to occur on five or fewer sites in the state are considered endangered.

It is important to note that the species lists are provided on a county-wide basis so species may or may not be present in the Indian-Kentuck Watershed. Species may be identified as endangered, threatened or rare in an area due to natural conditions or because of potential human impacts on that species natural habitat. The list was compiled over many years based on a combination of isolated observations and systematic species surveys.

The following is a listing of threatened or endangered species. Names are listed in common name followed by the scientific name.

ENDANGERED CRUSTACEAN (COPEPODA) WITHIN INDIAN-KENTUCK WATERSHED
Indiana Groundwater Copepod - Diacyclops indianensis
Lewis' Groundwater Copepod - Diacyclops lewisi

ENDANGERED MOLLUSK (MUSSELS) WITHIN INDIAN-KENTUCK WATERSHED
Clubshell - Pleurobema clava
Sheepnose - Plethobasus cyphyus
Snuffbox - Epioblasma triquetra

ENDANGERED AMPHIBIANS WITHIN INDIAN-KENTUCK WATERSHED
Eastern Hellbender - Cryptobranchus alleganiensis
Northern Crawfish Frog - Rana areolata circulosa

ENDANGERED REPTILES WITHIN INDIAN-KENTUCK WATERSHED
Kirtland's Snake - Clonophis kirtlandii

ENDANGERED MAMMALS WITHIN INDIAN-KENTUCK WATERSHED
Indiana Bat or Social Myotis - Myotis sodalis

ENDANGERED BIRD SPECIES WITHIN INDIAN-KENTUCK WATERSHED

Barn Owl - Tyto alba
Cerulean Warbler - Dendroica cerulea
Henslow's Sparrow - Ammodramus henslowii
King Rail - Rallus elegans
Loggerhead Shrike No Status - Lanius ludovicianus
Northern Harrier - Circus cyaneus
Peregrine Falcon No Status -Falco peregrinus
Sedge Wren -Cistothorus platensis

THREATENED VASCULAR PLANTS WITHIN INDIAN-KENTUCK WATERSHED

Maryland Meadow Beauty - Rhexia mariana var. mariana
Slick-seed Wild-bean - Strophostyles leiosperma
Straw Sedge - Carex straminea
Sullivantia - Sullivantia sullivantii
Tall Meadowrue - Thalictrum pubescens
Wild Chervil - Chaerophyllum procumbens var. shortii

ENDANGERED VASCULAR PLANTS WITHIN INDIAN-KENTUCK WATERSHED

American Water-Pennywort - Hydrocotyle Americana
Aster - Aster schreberi Schreber
Bottomland Broomrape - Orobanche riparia
Broom Panic-grass - Panicum scoparium
Clasping-leaved St. John's-Wort - Hypericum gymnanthum
Climbing Fern - Lygodium palmatum
Divided Toothwort - *Dentaria multifida*
Elliptical Rushfoil - *Crotonopsis elliptica*
Goose-Foot Corn-Salad - Valerianella chenopodiifolia
Gray Beardtongue - Penstemon canescens
Illinois Blackberry - Rubus centralis
Matted Broomspurge - Euphorbia serpens
Northern Bog Clubmoss - Lycopodiella inundata
Pursh Buttercup - Ranunculus pusillus
Running Buffalo Clover - Trifolium stoloniferum
Silky Dogwood - *Cornus amomum ssp. amomum*
Swamp Sunflower - Helianthus angustifolius
Virginia Mallow - Sida hermaphrodita

Preferred Habitat

According to the United States Fish and Wildlife Service the Indian-Kentuck Watershed area is home to the threatened and endangered Indiana bat. Indiana bats are vulnerable to disturbance because they hibernate in large numbers in old structures and a few small caverns within the watershed area. The watershed may provide important summer time habitat in the form of Shagbark Hickory trees along stream banks which provide cover while the bats raise their young. Threats that have contributed to the Indiana bat's decline include loss of summer habit, pesticides and other contaminants, and most recently, the disease “white nose syndrome”. Swarming takes place in surrounding wooded areas. Summer roosting and foraging habitat occur in wooded stream corridors and in bottomland and upland forests and woods.

Also, the endangered Barn Owl occupies IKW. Their habitat is fairly simple and similar to other birds; they enjoy open areas, such as grassy fields, old fields, wet meadows and wetland edges, around farms and rural towns. Daytime roost is usually an evergreen tree, belfry or barn. For breeding habitat, feeding areas must be near a nest site consisting of a suitable hollow or cavity in a tree or an appropriate man-made substitute.

However, “land use changes, particularly the decrease in the number of farms, have contributed to the decline of this species. Not only has foraging habitat been reduced, but the increased use of rodent poisons has resulted in a smaller food base. Natural nest sites in hollow trees are often limited, and human disturbance of the nest during incubation may cause nest abandonment. One common cause of mortality is predation of young barn owls by raccoons. Other mortality factors include exposure to harsh weather, electrocution by power lines, predation by dogs and great-horned owls, and accidental entanglement in farm and industrial machinery” (DNR, 2011).

The Henslow's Sparrow is a secretive bird that breeds in moist, shrubby grasslands and winters in the fields and open grassy areas of the pine forests of the southeastern US.

Freshwater mussels are one of the most endangered groups of animals in North America. Among the factors thought to be responsible for the decline are overharvest, siltation of their habitat from agriculture, poor land management, channelization, impoundments, competition from exotics, and pollution from herbicides, pesticides, and other chemicals. It is illegal to collect or disturb any native species of mussels in Indiana.

SUMMARY

The Indian Kentucky Watershed area is very diverse in relation to topography, soils, and landuse. This results in a mix of resource concerns such as soil erosion occurring on fields designated as HEL, which occurs in 59.6% of the watershed. Special precautions should be taken by those producers working HEL land to limit the amount of soil erosion occurring. As soil erodes, it can increase stream sedimentation, and often carries nutrients to open water sources. This may cause an increase in phosphorus and nitrogen levels within the water system, leading to unsuitable water quality.

While accurate estimates of the number of failing or failed septic systems could not be obtained for the project area, the fact that 96.4% of the soils have a very limited use and 3.3% have a somewhat limited use for septic fields makes failing septic systems suspect as an issue in the watershed. This could have a direct bearing on nutrient and ecoli levels within streams.

Interestingly most of the concerns identified by stakeholders within the watershed revolved around issues directly related to soil erosion and failing septic systems.

WATERSHED INVENTORY PART TWO

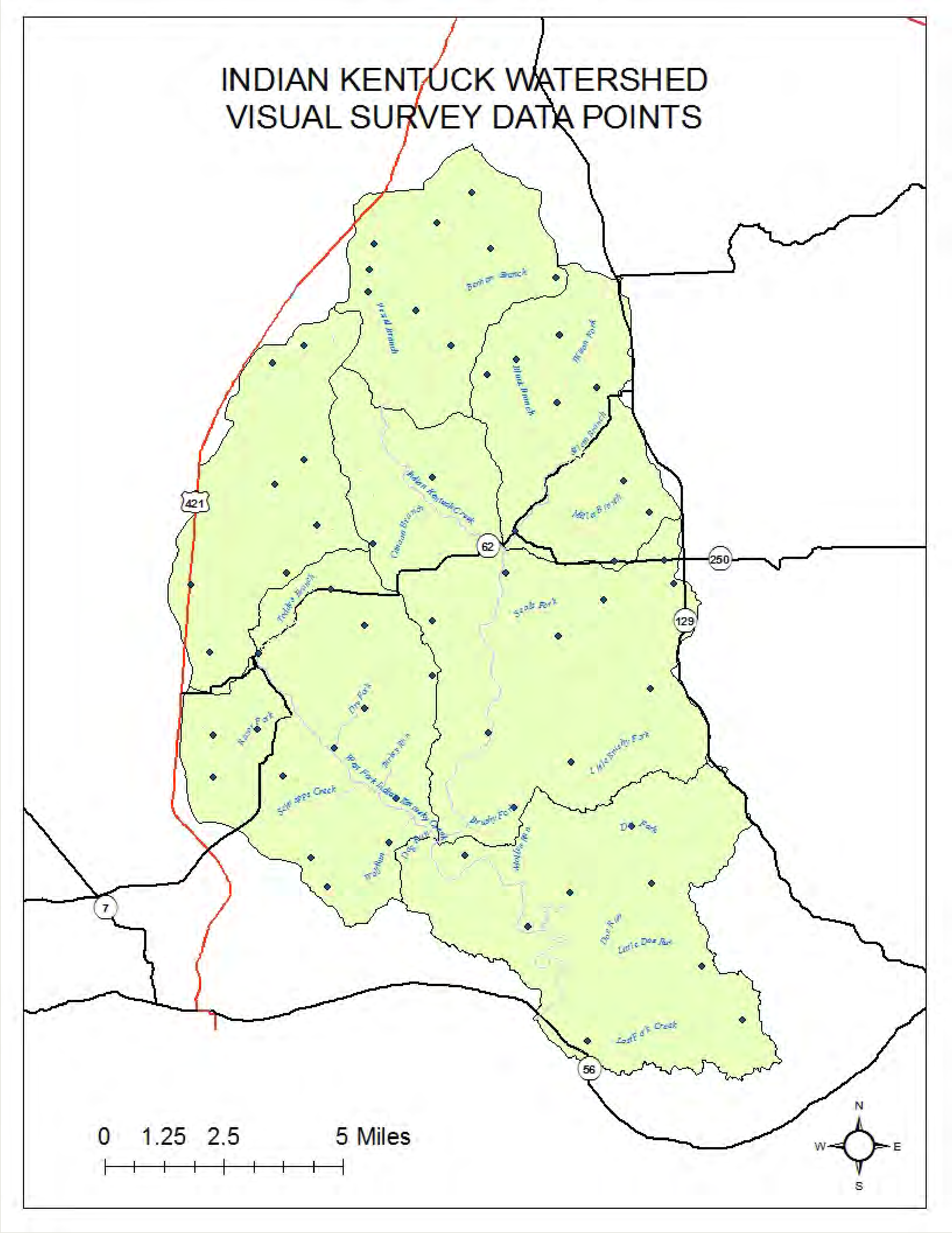
This section includes data collected from various points within the watershed to obtain an understanding of the present conditions within the watershed. Visual surveys, water sampling, and biological monitoring were methods used to collect information. Stakeholders within the watershed were also involved by providing watershed concerns at public meetings and also participating in a watershed survey mailed to 395 residents within the watershed.

Visual Survey Assessment

Part of the inventory process of the Indian-Kentuck Watershed involved visual observations of landuses and conditions of various points within the watershed. This data was collected by traveling the watershed and completing windshield surveys at various points. Figure 15 shows the 64 different sites that were selected to collect visual data. The type of information collected includes residue on cultivated cropland, pasture and hayland conditions, livestock access to water sources, buffers along streams, woodland conditions, septic, and trash issues. Visual data was collected in the years 2011 and 2013 at the same points each year. The Indian-Kentuck Steering Committee plans to continue this visual survey on an annual basis to document improvement or degradation of resources at these 64 data point sites. Each point assessed is given a numeric score which weighs into the overall score of the watershed. If resource conditions are favorable a site will receive 0 points, if there are water quality issues at the site it receives 40 points. Using this method the average condition of the watershed can be evaluated numerically indicating improvement or degradation over time, as the survey is intended to be completed during the same time and at the same points each year. Below are charts showing the visual assessment using point values. A decrease in point values from one year to the next indicates that resource conditions have improved. Charts in this section cover the entire Indian-Kentuck Watershed and are represented using the twelve digit HUC's. Figure 4 identifies the location of each HUC. There is a level of inconsistency in the visual assessment data from one year to the next due to differences in assessment team members. For instance if crop residue levels are 35 percent in a crop field it may be interpreted as 25 percent by one individual and 35 percent by another. However, upon analyzing the data it is quite obvious that there are trends that re-appear in specific HUC's. This information can be quite useful in identifying critical areas of concern within the watershed.

In addition to observing buffer conditions along streams during the visual survey, a desktop survey of stream buffer condition for the watershed was also completed. Perennial streams with less than 150 foot buffers were identified using GIS and aerial photos. Because some features and vegetation are not always clear in the aerial photos, it's possible that some of the segments identified as needing buffers in the desktop survey have sufficient buffers. Nevertheless, the desktop survey is a useful tool to help identify areas that may benefit from additional stream buffers. These maps are presented in Figure 14 page 22

Figure 15: Indian-Kentuck Watershed Visual Survey Data Points



VISUAL ASSESSMENT GRAPHS & MAPS

VESTAL BRANCH (051401010201)

Vestal Branch is the uppermost subwatershed and is approximately 10,989 acres. The major land uses are cultivated crops (45%), forest (43%), with some pasture/hayland (7%) shown below in Figures 16 and 17. IDEM sample sites 1 and 2 are in this subwatershed, as well as nine visual assessment sites.

Figure 16: Vestal Branch Visual Assessment Map

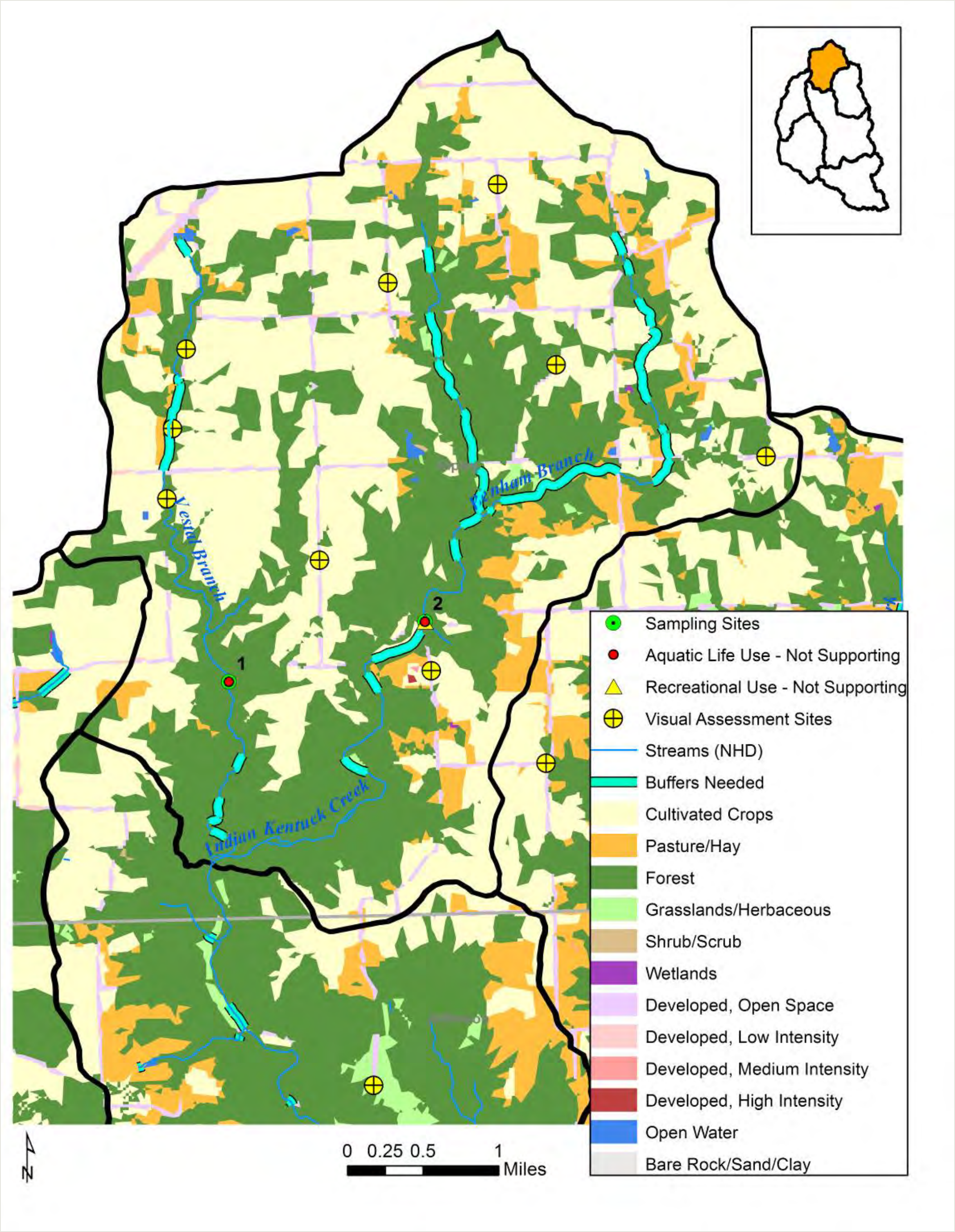
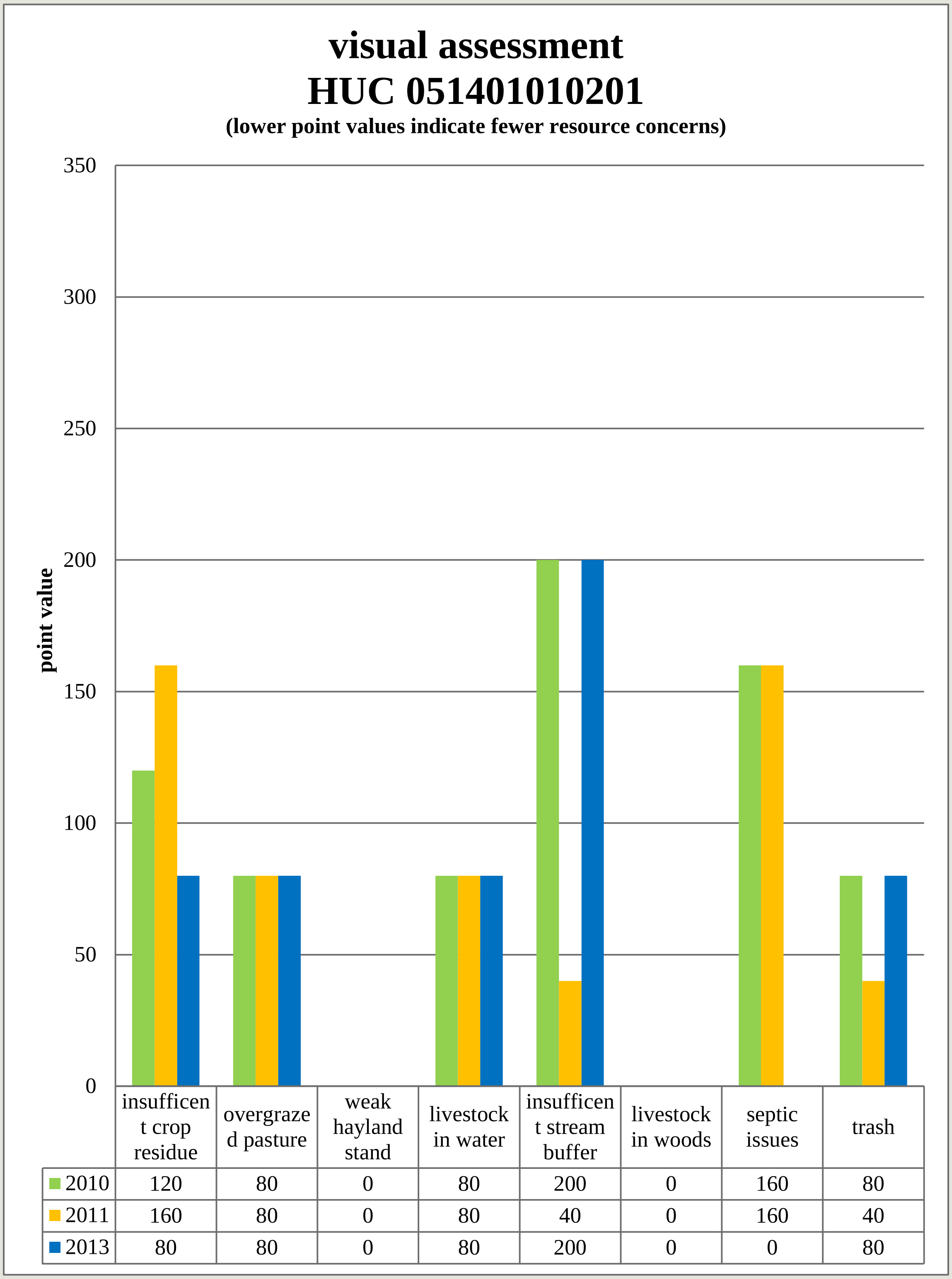


Figure 17: Vestal Branch Visual Assessment Graph

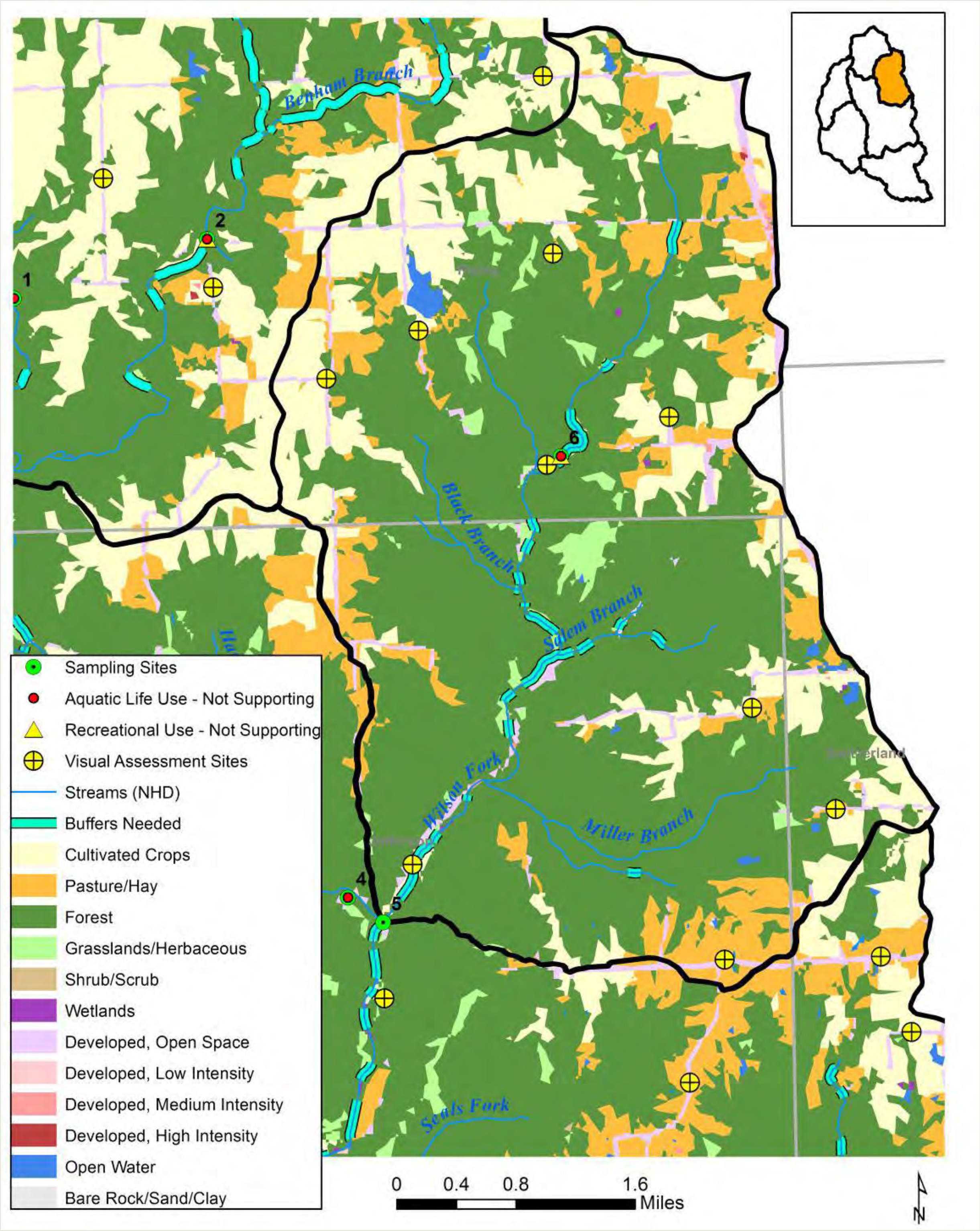


	insufficient crop residue	overgrazed pasture	weak hayland stand	livestock in water	insufficient stream buffer	livestock in woods	septic issues	trash
2010	120	80	0	80	200	0	160	80
2011	160	80	0	80	40	0	160	40
2013	80	80	0	80	200	0	0	80

Wilson Fork (051401010202)

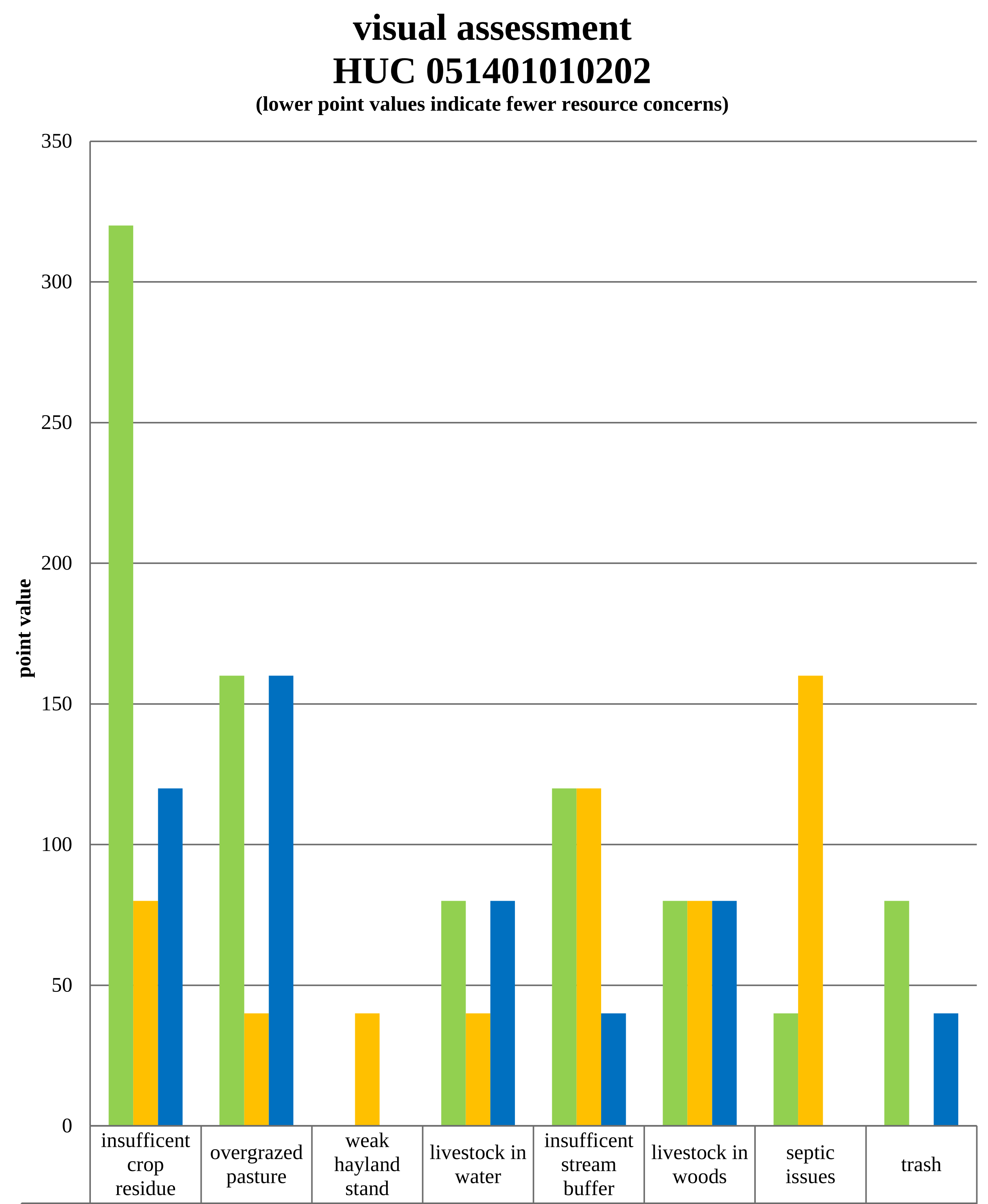
Wilson Fork is approximately 11,751 acres. The major land uses are cultivated crops (18%), forest (66%), with some pasture/hayland (10%) shown below in Figures 18 and 19. IDEM sample site 6 is in this subwatershed, as well as nine visual assessment sites.

Figure 18: Wilson Fork Visual Assessment Map



Figure

19: Wilson Fork Visual Assessment Graph



	insufficent crop residue	overgrazed pasture	weak hayland stand	livestock in water	insufficent stream buffer	livestock in woods	septic issues	trash
2010	320	160	0	80	120	80	40	80
2011	80	40	40	40	120	80	160	0
2013	120	160	0	80	40	80	0	40

Headwaters West Fork Indian Kentuck (051401010203)

Headwaters West Fork is approximately 11,426 acres. The major land uses are cultivated crops (31%), forest (53%), with some pasture/hayland (10%) shown below in Figures 20 and 21. IDEM sample sites 12 and 13 are in this subwatershed, as well as nine visual assessment sites.

Figure 20: Headwaters West Fork Indian Kentuck Map

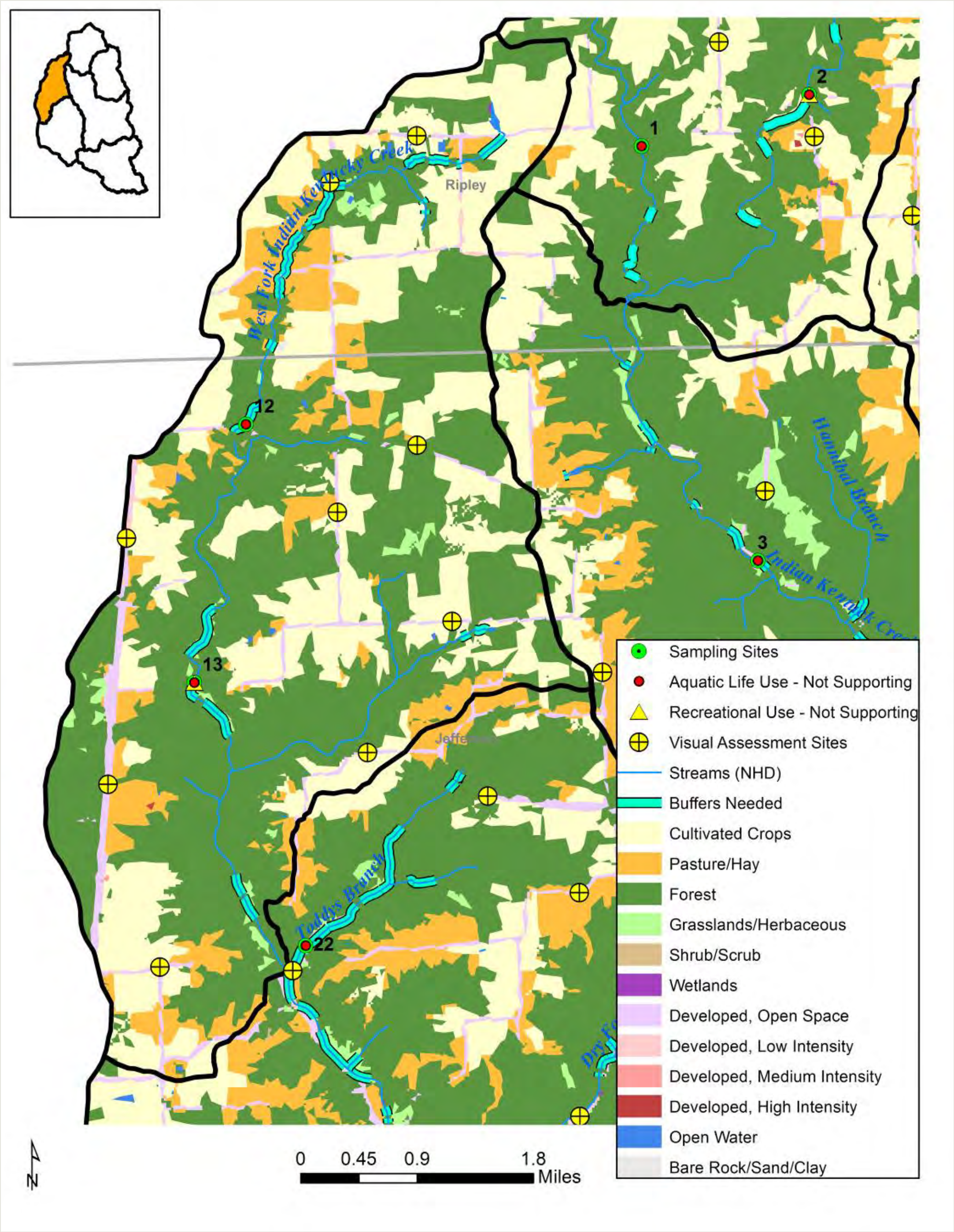
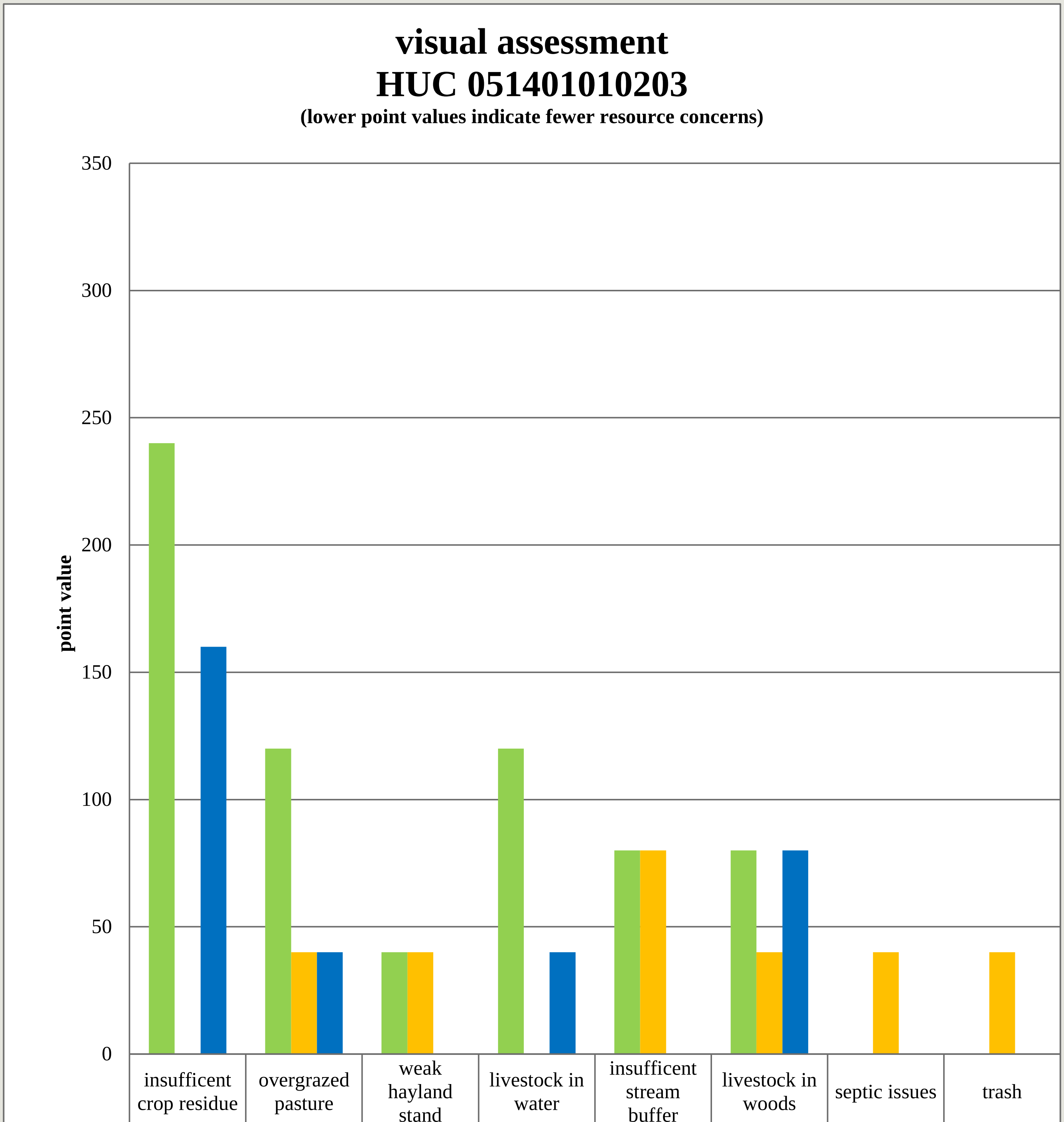


Figure 21: Headwaters West Fork Indian Kentuck Graph



	insufficent crop residue	overgrazed pasture	weak hayland stand	livestock in water	insufficent stream buffer	livestock in woods	septic issues	trash
2010	240	120	40	120	80	80	0	0
2011	0	40	40	0	80	40	40	40
2013	160	40	0	40	0	80	0	0

West Fork Indian Kentuck (051401010204)

West Fork is approximately 18,019 acres. The major land uses are cultivated crops (11%), forest (65%), with some pasture/hayland (15%) shown below in Figures 22 and 23. IDEM sample sites 19, 20, 21, and 22 are in this subwatershed, as well as fourteen visual assessment sites.

Figure 22: West Fork Indian Kentuck Visual Assessment Map

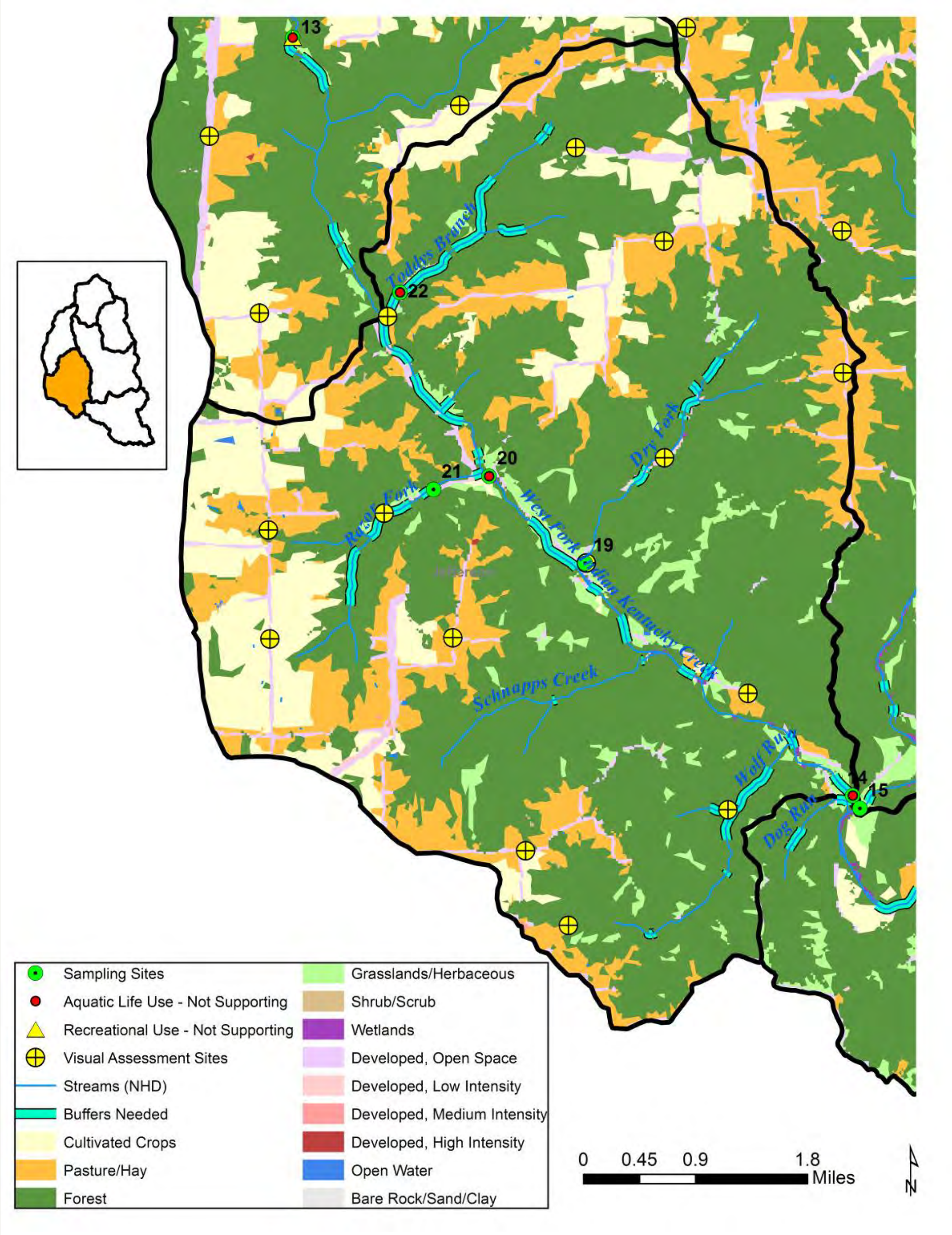
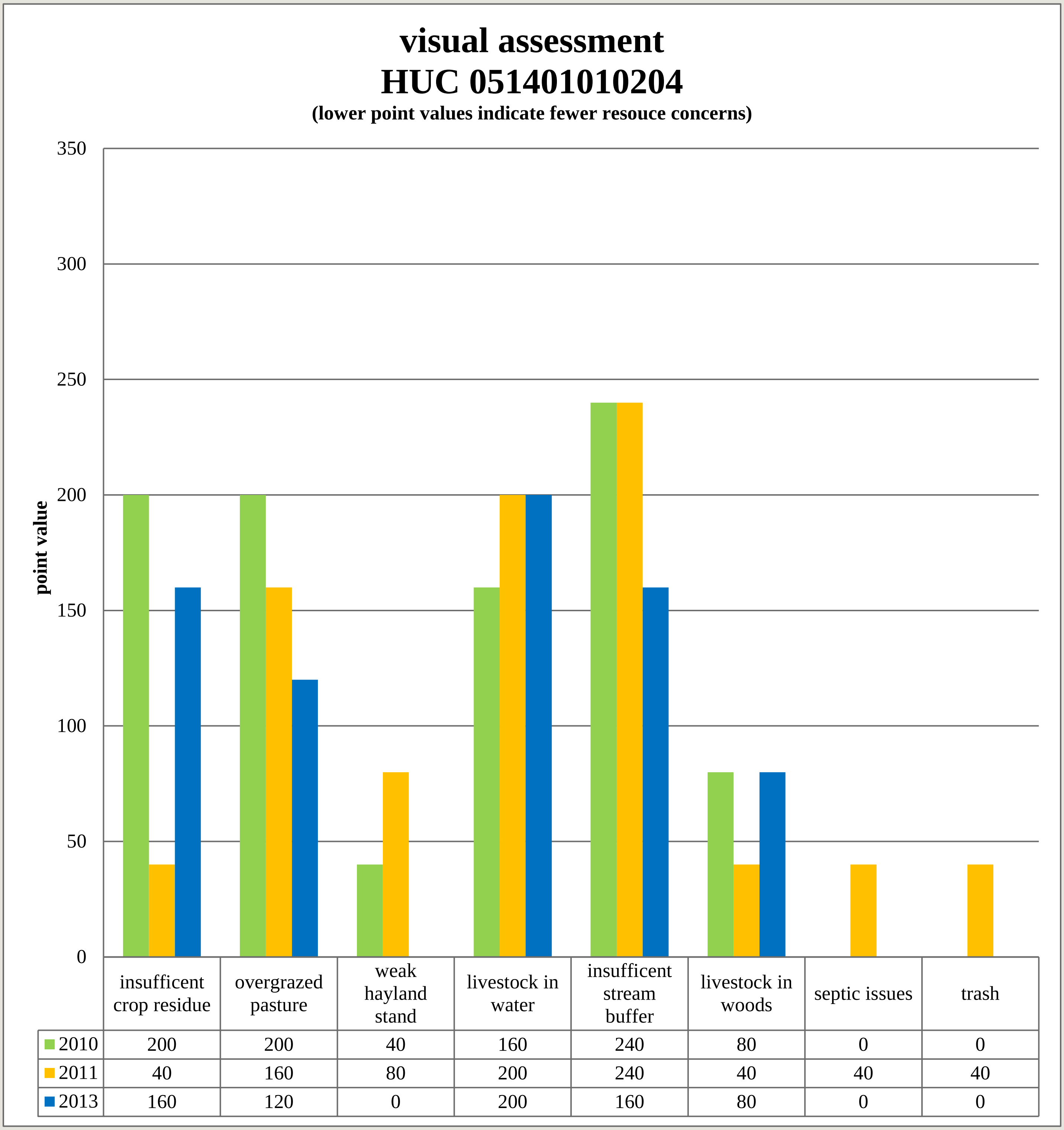


Figure 23: West Fork Indian Kentuck Visual Assessment Graph



	insufficent crop residue	overgrazed pasture	weak hayland stand	livestock in water	insufficent stream buffer	livestock in woods	septic issues	trash
2010	200	200	40	160	240	80	0	0
2011	40	160	80	200	240	40	40	40
2013	160	120	0	200	160	80	0	0

Brushy Fork (051401010205

Brushy Fork is approximately 25,830 acres. The major land uses are cultivated crops (7%), forest (70%), with some pasture/hayland (14%) shown below in Figures 24 and 25. IDEM sample sites3,4,5,7,8,9,10, and 11 are in this subwatershed, as well as twelve visual assessment sites.

Figure 24: Brushy Fork Visual Assessment Map

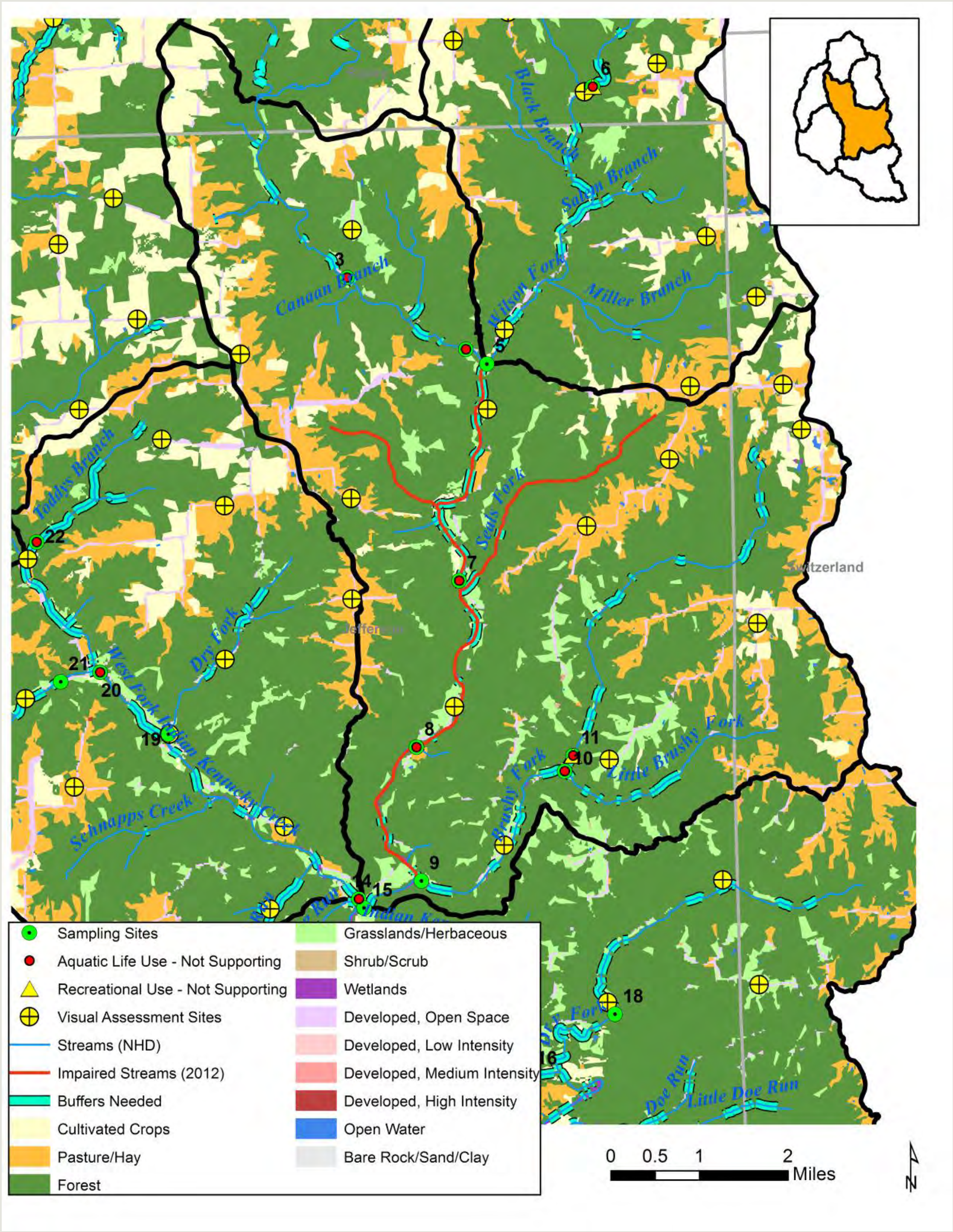
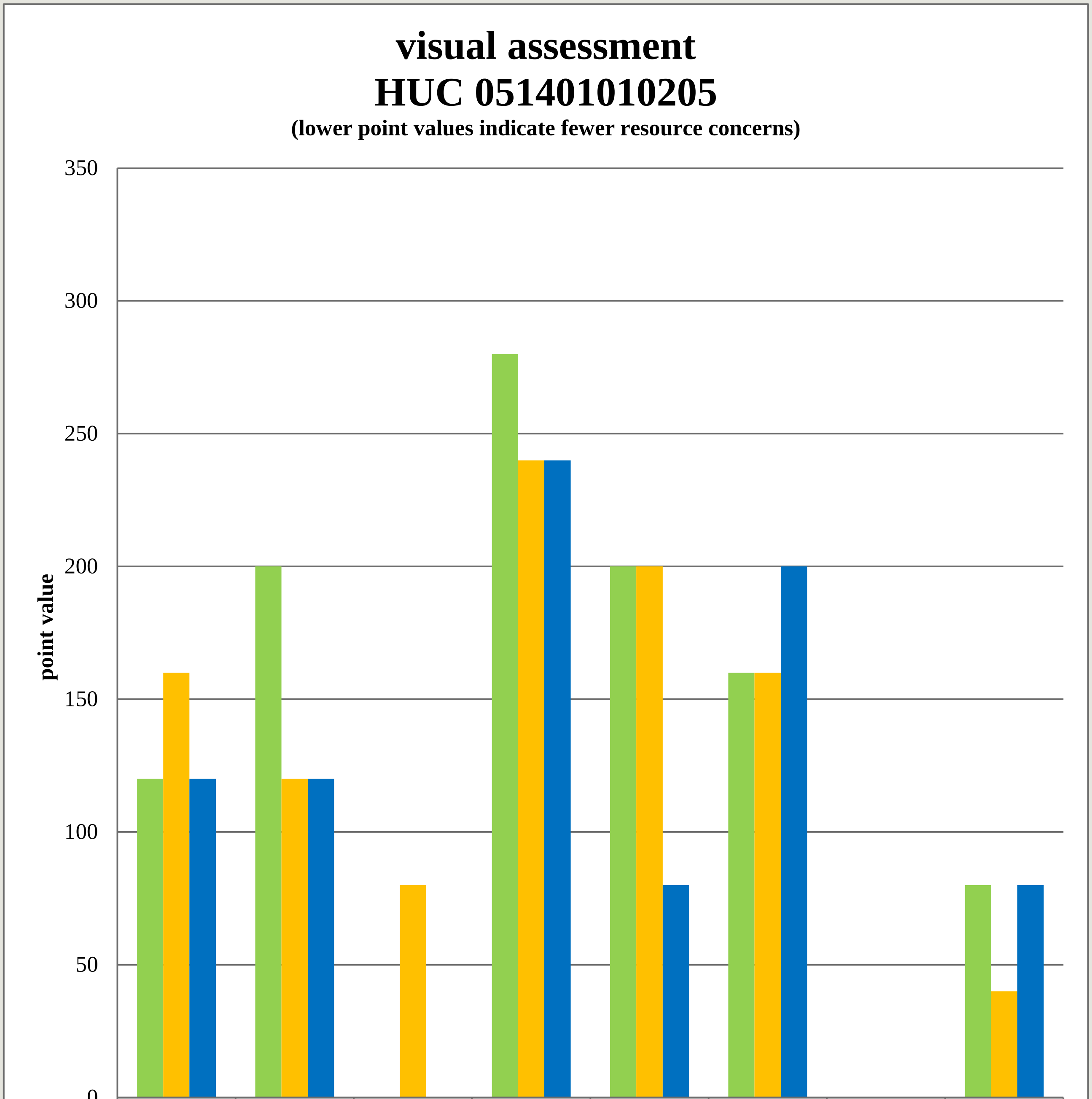


Figure 25: Brushy Fork Visual Assessment Graph

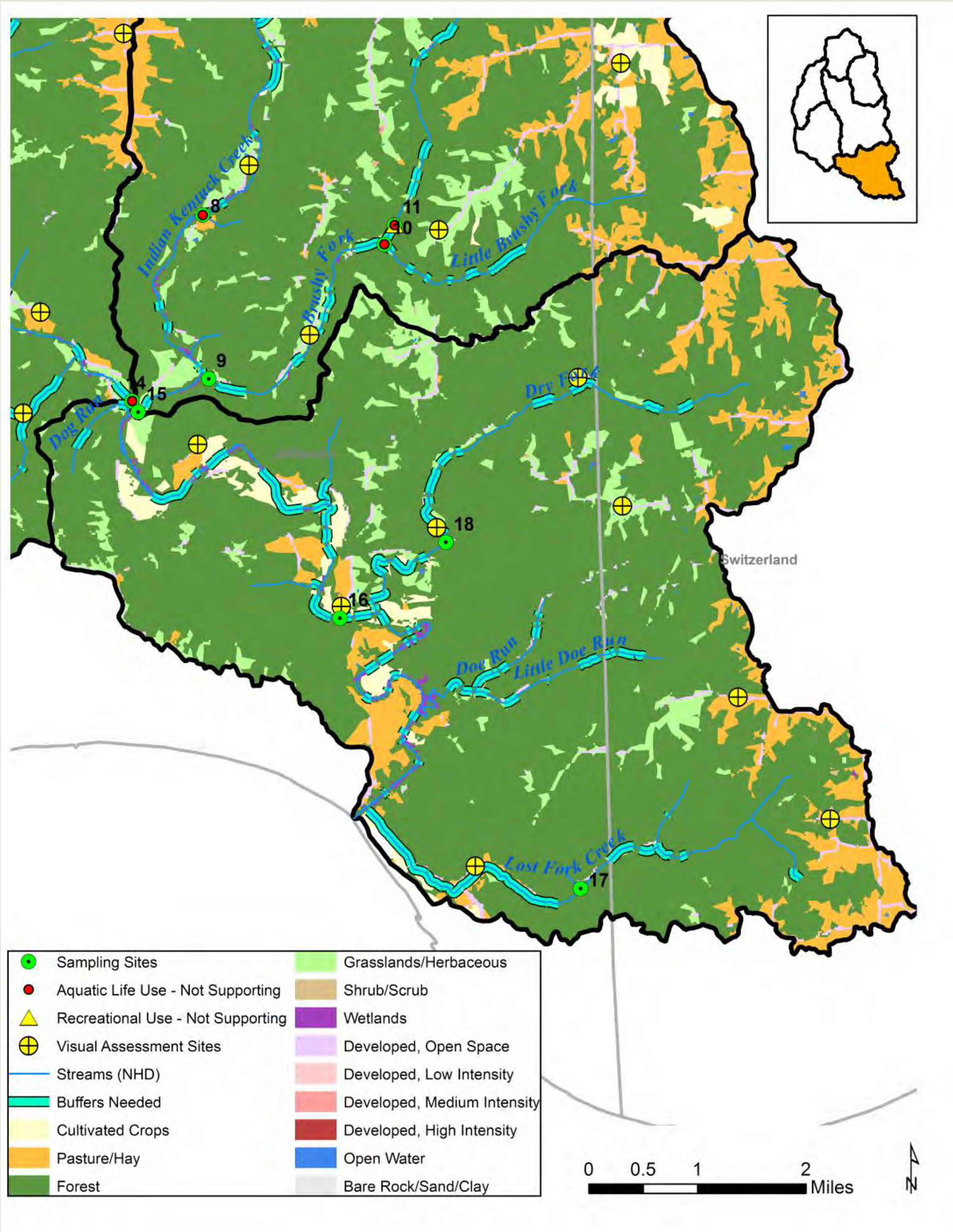


	insufficent crop residue	overgrazed pasture	weak hayland stand	livestock in water	insufficent stream buffer	livestock in woods	septic issues	trash
2010	120	200	0	280	200	160	0	80
2011	160	120	80	240	200	160	0	40
2013	120	120	0	240	80	200	0	80

Doe Run (051401010206)

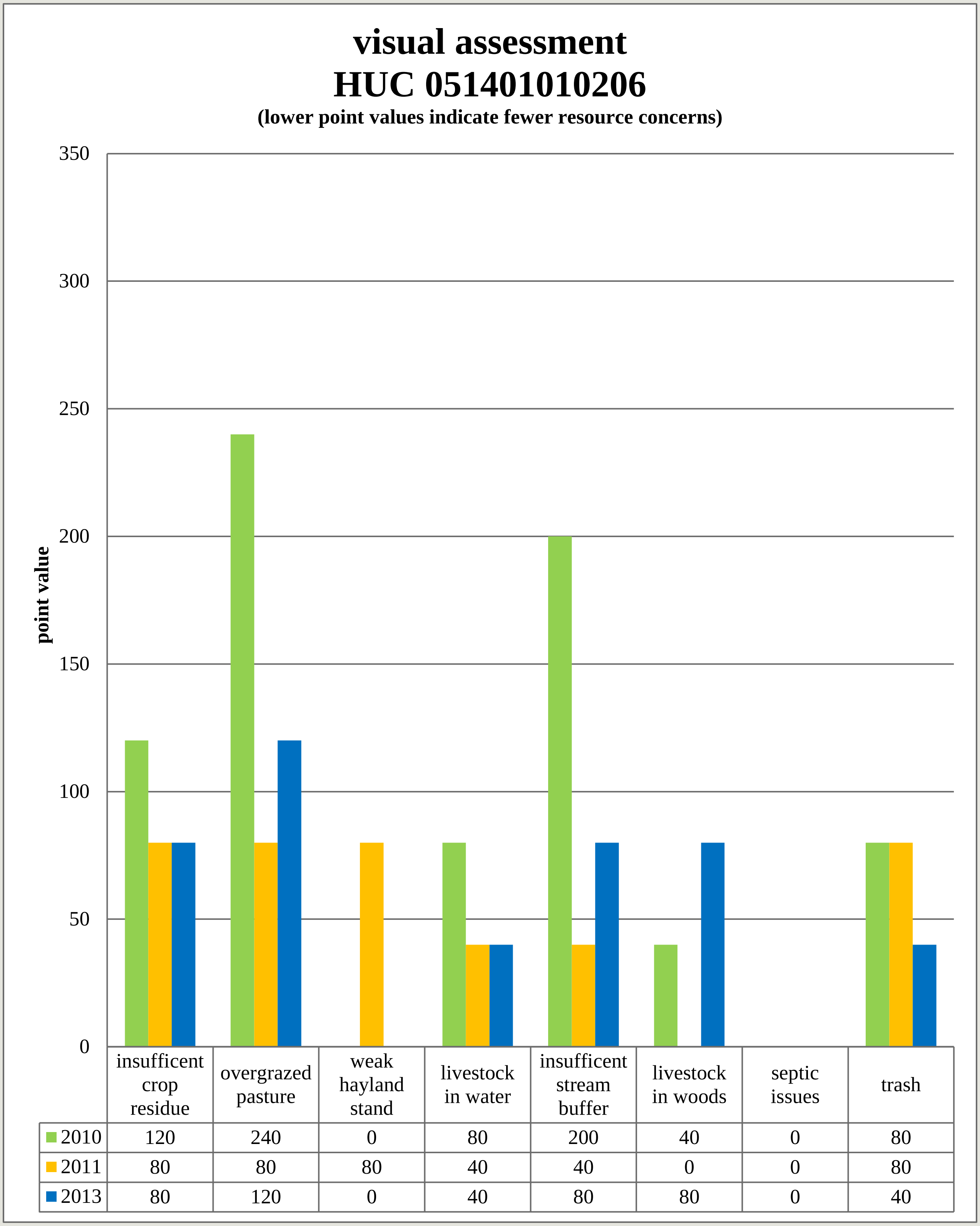
Doe Run is approximately 19,780 acres. The major land uses are cultivated crops (3%), forest (80%), with some pasture/hayland (9%), with grassland (5%) and open space (2%) shown below in Figures 26 and 27. IDEM sample sites 14,15,16, 17, and 18 are in this subwatershed, as well as eight visual assessment sites.

Figure 26: Doe Run Visual Assessment Map



Doe Run (051401010206)

Figure 27: Doe Run Visual Assessment Chart



	insufficent crop residue	overgrazed pasture	weak hayland stand	livestock in water	insufficent stream buffer	livestock in woods	septic issues	trash
2010	120	240	0	80	200	40	0	80
2011	80	80	80	40	40	0	0	80
2013	80	120	0	40	80	80	0	40

Water Quality Assessment

There were several water quality parameters recognized at the beginning of the project that the Indian-Kentuck Steering Committee felt were important to monitor in order to create a benchmark of existing water quality conditions. It was noted by the Steering Committee that a portion of Indian Kentuck was designated as impaired for E. coli and biotic communities on IDEM's 2012 303(d) list.

Water monitoring was completed by IDEM staff in 2012 and 2013 with testing parameters that included E.coli, nitrate + nitrite, total phosphorus, turbidity, pH, dissolved oxygen, ammonia, total Kjeldahl nitrogen, TSS, and flow. Chemical sampling was conducted monthly for a year (May 2012 – April 2013), but not all sites were able to be sampled monthly due to the drought in 2012. E. coli samples were collected once a week for five weeks in April 2013 to determine the geometric mean. Biological assessment was also completed by IDEM personnel to assess the health of the stream. The biological assessment gauges the streams ability to support different types of aquatic life some of which can thrive only in pristine waters. Figure 28 shows the 22 different sites tested and Figure 30 lists the IDEM Sampling Sites with the 12 digit HUC with the latitude and longitude.

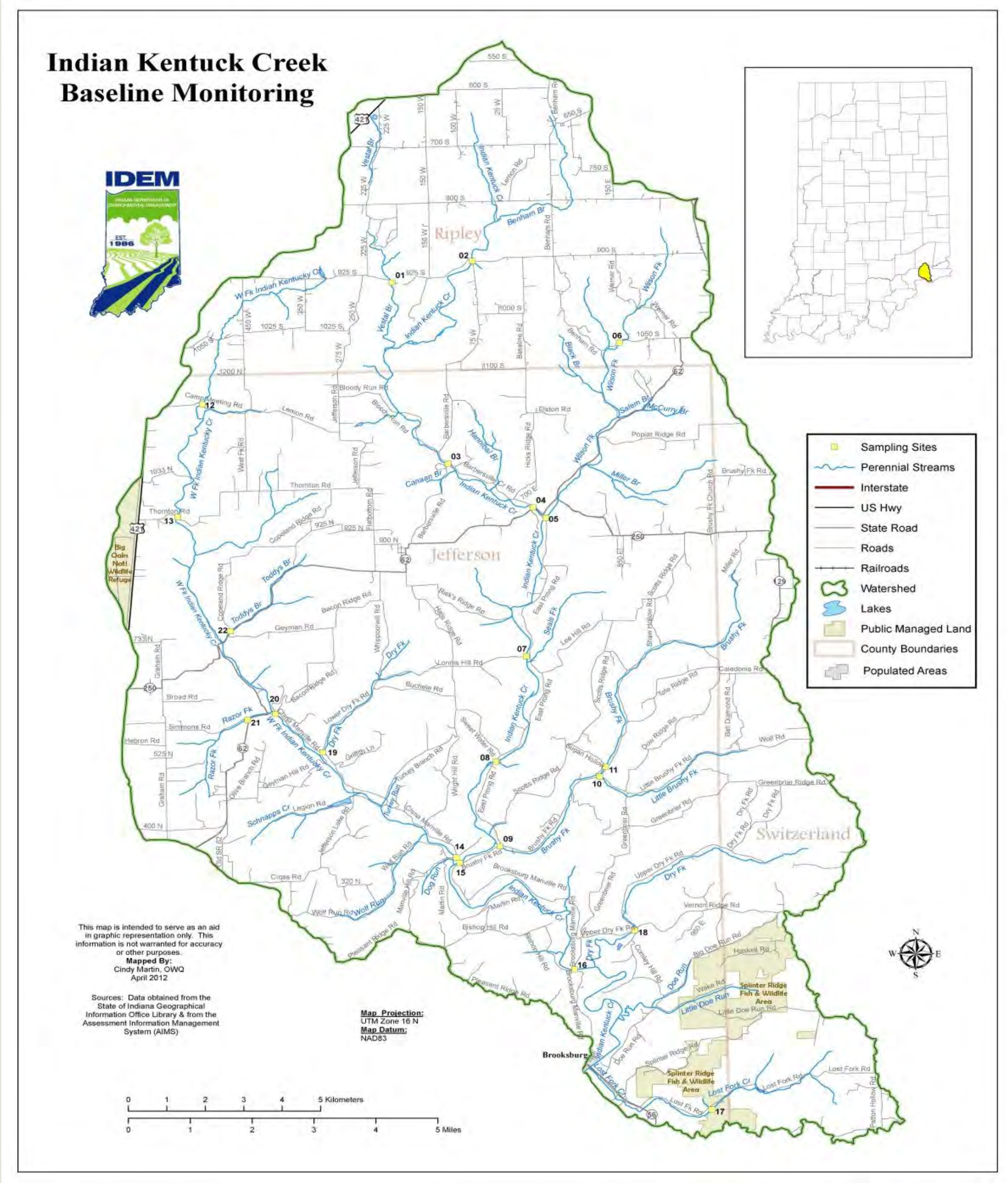


Figure 28: Indian-Kentucky Creek Baseline Monitoring

In order to assess the condition of the streams in the watershed, the Steering Committee selected water quality targets for the parameters being monitored. Most of the targets are based on Indiana water quality standards (Indiana Administrative Code), or in some cases, EPA recommended values shown in Figure 29.

Figure 29: TARGET VALUES SET BY THE INDIAN KENTUCK STEERING COMMITTEE

Parameter	Target	Source
Dissolved Oxygen	not < 4 mg/L and not > 12 mg/L	327 IAC 2-1-6
Total Ammonia (NH3)	Range between 0.0 and 0.21 mg/L depending upon temperature and pH	(327 IAC 2-1-6)
pH	> 6 and < 9	327 IAC 2-1-6
Nitrate + Nitrite	< 1.5 mg/L	US EPA reference level (2000)
Total Phosphorus	< 0.076 mg/L	US EPA recommendation
Total Suspended Solids	< 25 mg/L	US EPA recommendation
Total Kjeldahl Nitrogen (TKN)	< 0.591 g/L	US EPA recommendation (2000)
Escherichia Coli	235 CFU/100 ml (single sample) or 125 CFU/100 ml (geo mean-5 equally spaced samples over a 30 day period)	327 IAC 2-1.5-8
Turbidity	< 10.4 NTU	US EPA recommendation (2000)
Macroinvertebrates Index of biotic Integrity (mIBI)	>35 points	IDEM
Fish Index of Biotic Integrity (IBI)	>35 points	IDEM
Qualitative Habitat Evaluation Index (QHEI)	>51 points	IDEM

‘

Figure 30: IDEM Sampling Sites

IDEM Site #	Map ID #	HUC 12	Stream	Latitude	Longitude
OSK-02-0001	1	51401010201	Vestal Branch	38.937	-85.298
OSK-02-0002	2	51401010201	Indian Kentuck Creek	38.942	-85.274
OSK-02-0003	3	51401010205	Indian Kentuck Creek	38.890	-85.283
OSK-02-0004	4	51401010205	Indian Kentuck Creek	38.878	-85.258
OSK-02-0005	5	51401010202	Wilson Fork	38.875	-85.254
OSK-02-0006	6	51401010202	Wilson Fork	38.920	-85.230
OSK-02-0007	7	51401010205	Indian Kentuck Creek	38.840	-85.260
OSK-02-0008	8	51401010205	Indian Kentuck Creek	38.813	-85.270
OSK-02-0009	9	51401010205	Brushy Fork	38.791	-85.269
OSK-02-0010	10	51401010205	Little Brushy Fork	38.808	-85.239
OSK-02-0011	11	51401010205	Brushy Fork	38.811	-85.237
OSK-02-0012	12	51401010203	West Fork Indian Kentuck Creek	38.906	-85.356
OSK-02-0013	13	51401010203	West Fork Indian Kentuck Creek	38.877	-85.364
OSK-02-0014	14	51401010204	West Fork Indian Kentuck Creek	38.788	-85.283
OSK-02-0015	15	51401010205	Indian Kentuck Creek	38.786	-85.282
OSK-02-0016	16	51401010206	Indian Kentuck Creek	38.758	-85.248
OSK-02-0017	17	51401010206	Lost Fork Creek	38.722	-85.208
OSK-02-0018	18	51401010206	Dry Fork	38.768	-85.230
OSK-02-0019	19	51401010204	Dry Fork	38.816	-85.322
OSK-02-0020	20	51401010204	West Fork Indian Kentuck Creek	38.826	-85.336
OSK-02-0021	21	51401010204	Razor Fork	38.824	-85.344
OSK-02-0022	22	51401010204	Toddys Branch	38.847	-85.349

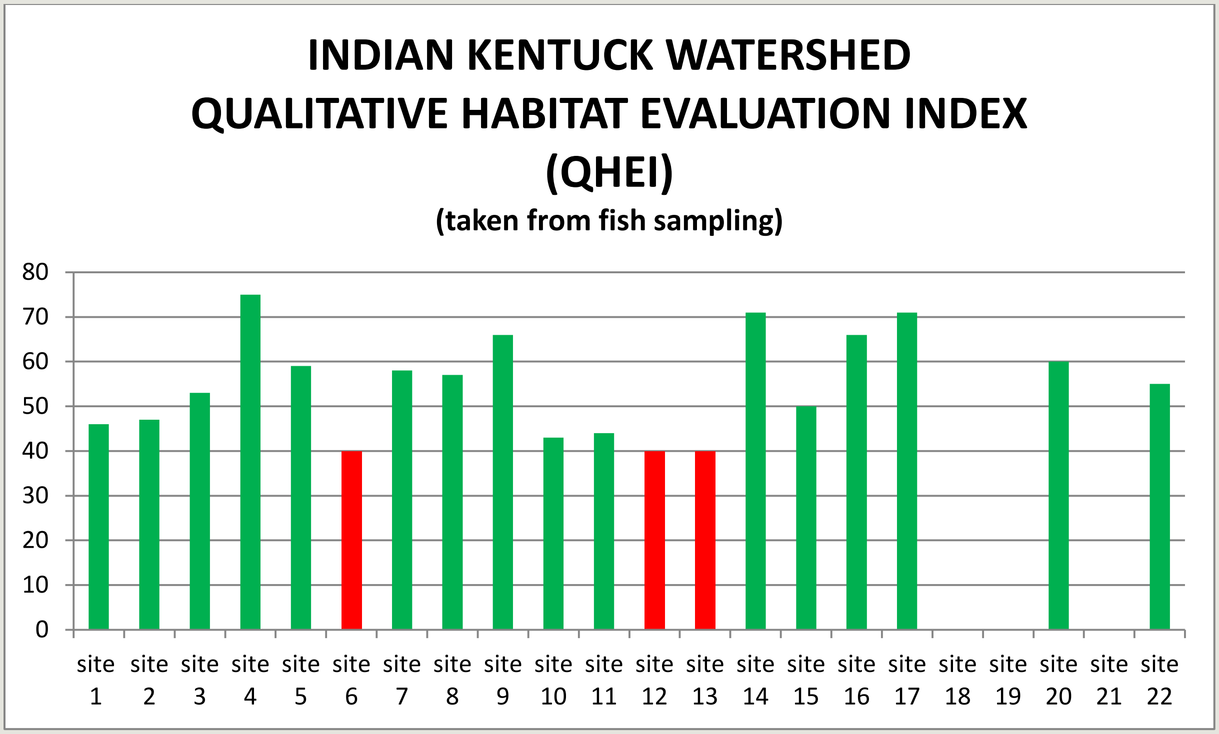
QUALITATIVE HABITAT EVALUATION INDEX (QHEI)

Habitat is measured using an index called the qualitative habitat evaluation index (QHEI). The QHEI is composed of six metrics including substrate composition, in stream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle-run quality, and map gradient. Observations of stream conditions along a 200 foot (61 meter) reach are recorded on the QHEI datasheet. Each metric is then scored individually then summed to provide the total QHEI score. The QHEI score generally ranges from 20 to 100. Also noted in the results is site 18, 19 and 21 reported no data due to a dry stream bed during monitoring and site 6, 12, and 13 had poor habitat.

QHEI Narrative score	
Excellent	> 70
Good	55 - 69
Fair	43 - 54
Poor	30 - 42
Very Poor	< 30

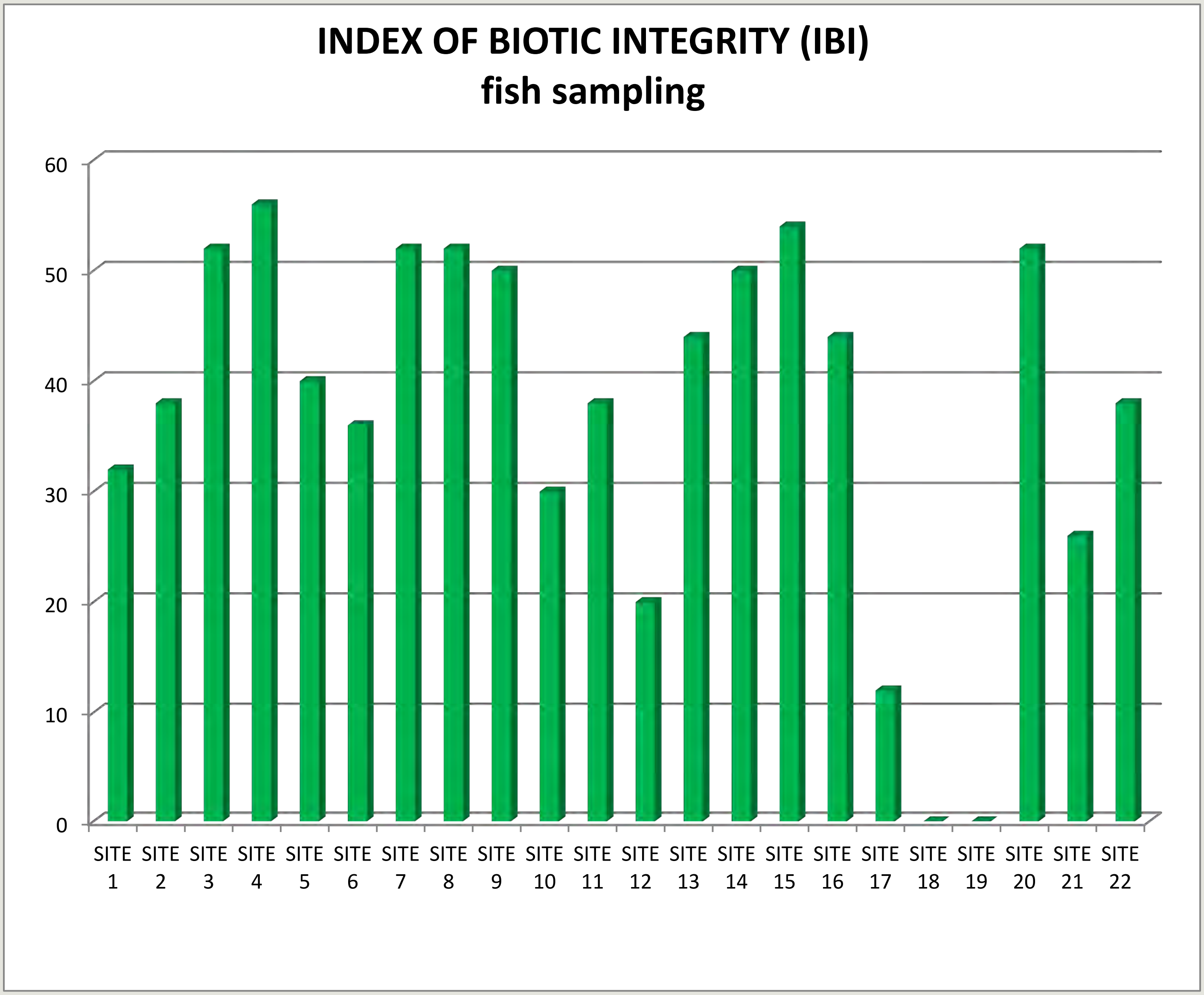
Figure 31: Indian-Kentuck QHEI (fish sampling)

Red bars indicate poor habitat



INDEX OF BIOTIC INTEGRITY (IBI) (fish sampling)
The IBI is used to calculate the results of fish assemblage data. The IBI is composed of 12 metrics that assess the community's species and trophic composition (feeding and reproductive guilds) and fish condition and health. The total IBI score, integrity class and attributes help define fish community characteristics. The chart below (figure 32), uses total IBI score, integrity class and attributes to define the fish community characteristics in Indiana streams and rivers Sites 18 and 19 were dry due to drought and no sampling was completed.

Figure 32: Index of IBI (fishing sampling)



IBI SCALE:

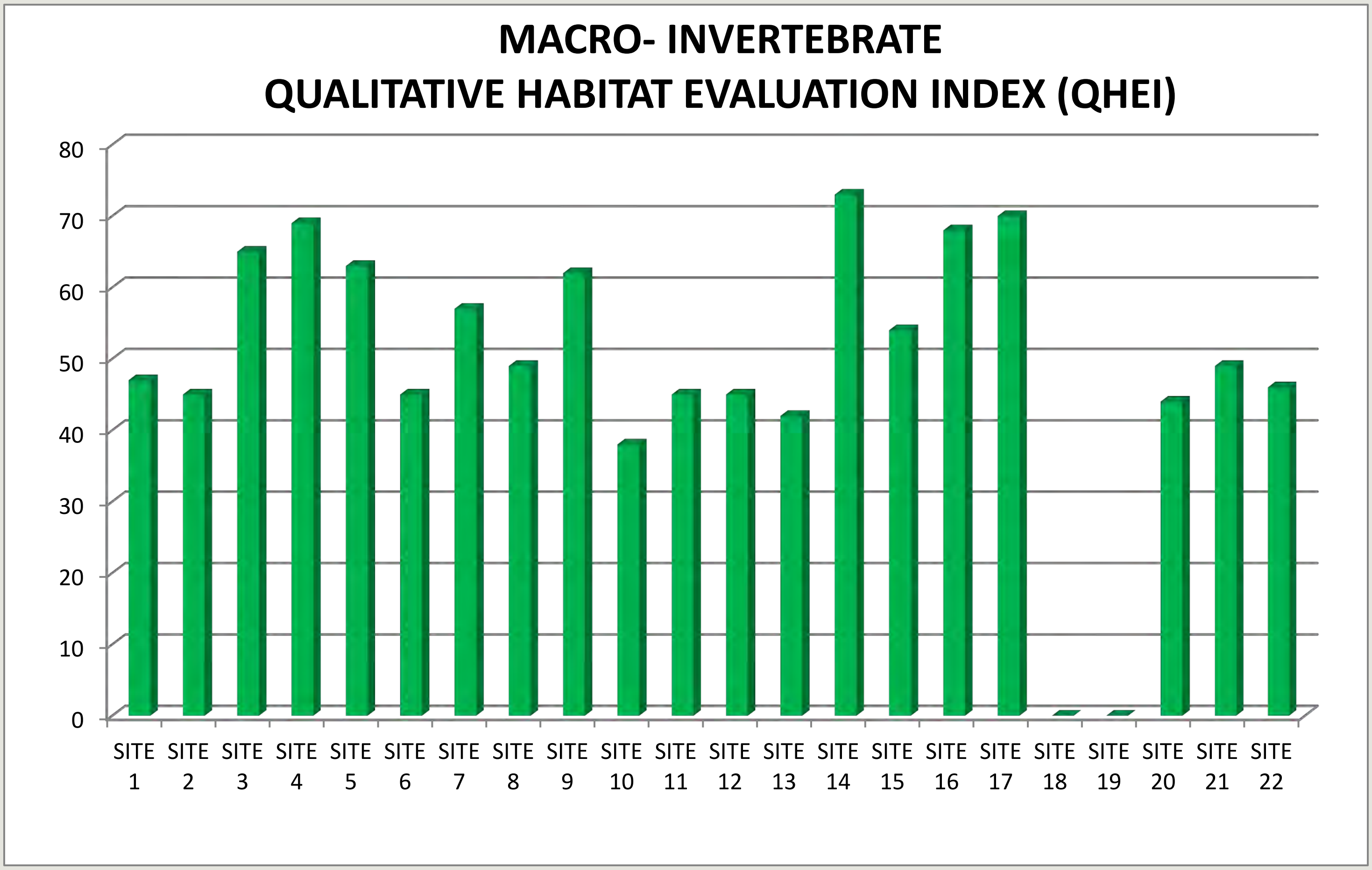
58-60 Excellent 48-52 Good 40-44 Fair 28-34 Poor 12-22 Very Poor <12 No Fish Captured

Macro-Invertebrate Qualitative Habitat Evaluation Index (QHEI)

The QHEI is composed of an array of metrics that evaluate stream substrate and gradient, in stream cover, stream channel, pool/riffle and riparian quality. These physical habitat attributes are important in explaining the species presence, absence, and composition of fish communities and other aquatic life (e.g. invertebrates) in a stream. The QHEI is a macro-scale approach that measures emergent properties of habitat (sinuosity, pool/riffle development) rather than individual factors that shape these characteristics (current velocity, depth, substrate size).

QHEI Narrative score	
Excellent	> 70
Good	55 - 69
Fair	43 - 54
Poor	30 - 42
Very Poor	< 30

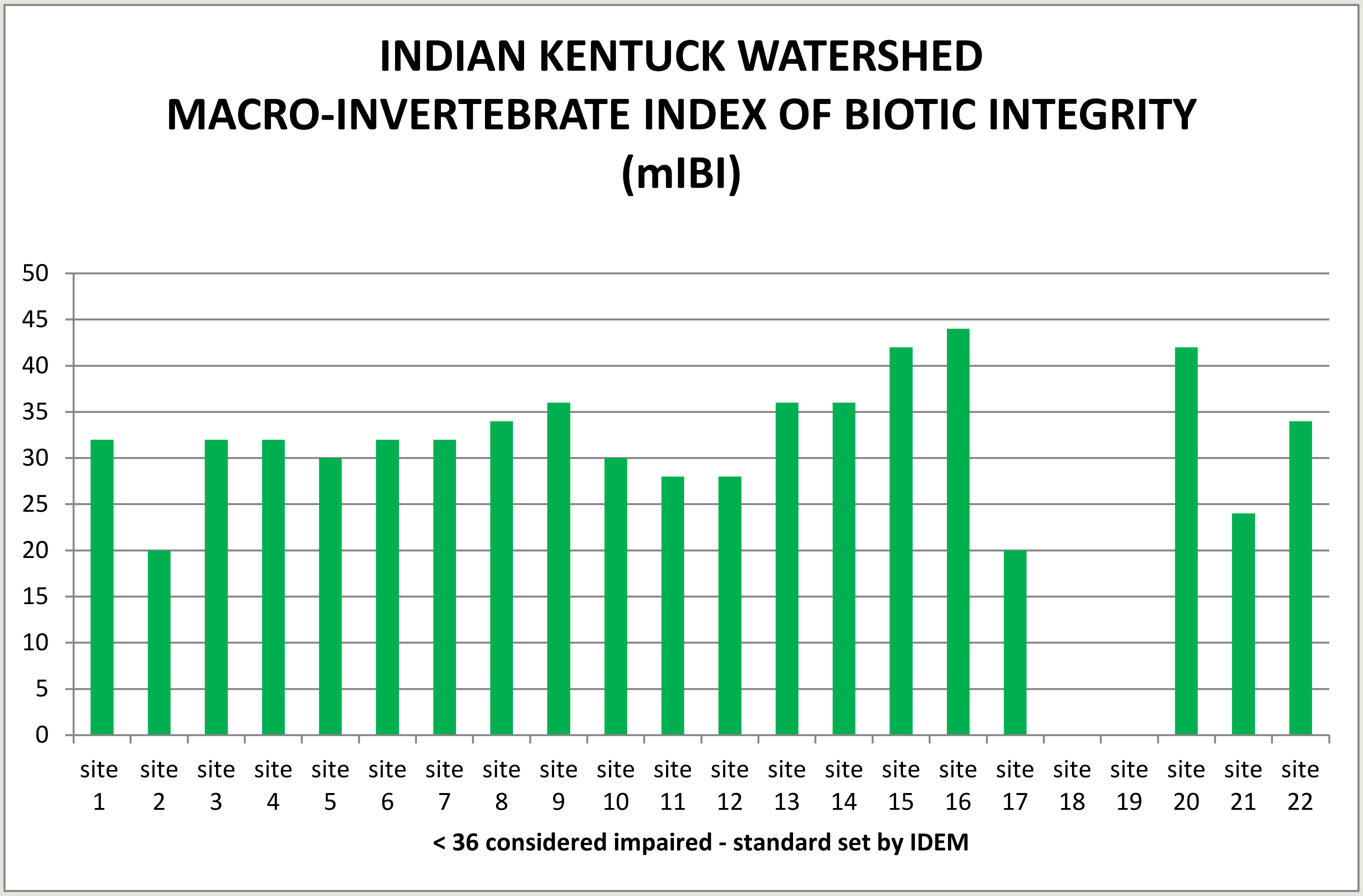
Figure 33: Macro-Invertebrate QHEI



MACRO-INVERTEBRATE INDEX OF BIOTIC INTEGRITY (mIBI)
Benthic macroinvertebrates are defined as "aquatic invertebrates that live in the bottom parts of our waters. They make good indicators of watershed health because they live in the water for all or most of their lives, stay in areas suitable for their survival, are easy to collect, differ in their tolerance to amount and types of pollution, are easy to identify in a laboratory, often live for more than one year, have limited mobility, and are indicators of environmental condition." (U.S. EPA, 2007) Pollution-sensitive organisms such as mayflies, stoneflies, and caddisflies are more susceptible to the effects of physical or chemical changes in a stream than other organisms. These organisms act as indicators of the absence of pollutants. Pollution-tolerant organisms such as midges and worms are less susceptible to changes in physical and chemical parameters in a stream. The presence or absence of such indicator organisms is an indirect measure of pollution.

The benthic community in the streams is evaluated using IDEM's macroinvertebrates Index of Biotic Integrity (mIBI). The mIBI is a multi-metric index that combines several aspects of the benthic community composition. As such, it is designed to provide a complete assessment of a creek's biological integrity. The mIBI consists of ten metrics which measure the species richness, evenness, composition, and density of the benthic community at a given site. The mIBI is calculated by averaging the classification scores for the ten metrics. mIBI impairment can be caused by lack of habitat, water pollution, or a combination of the two. It should be noted that many sites are shown as being impaired but during the testing period conditions were very dry which may have skewed test results somewhat. Sites 18 & 19 could not be tested due to the dry conditions.

Figure 34: Indian-Kentucky Watershed Macro-Invertebrate (mIBI)

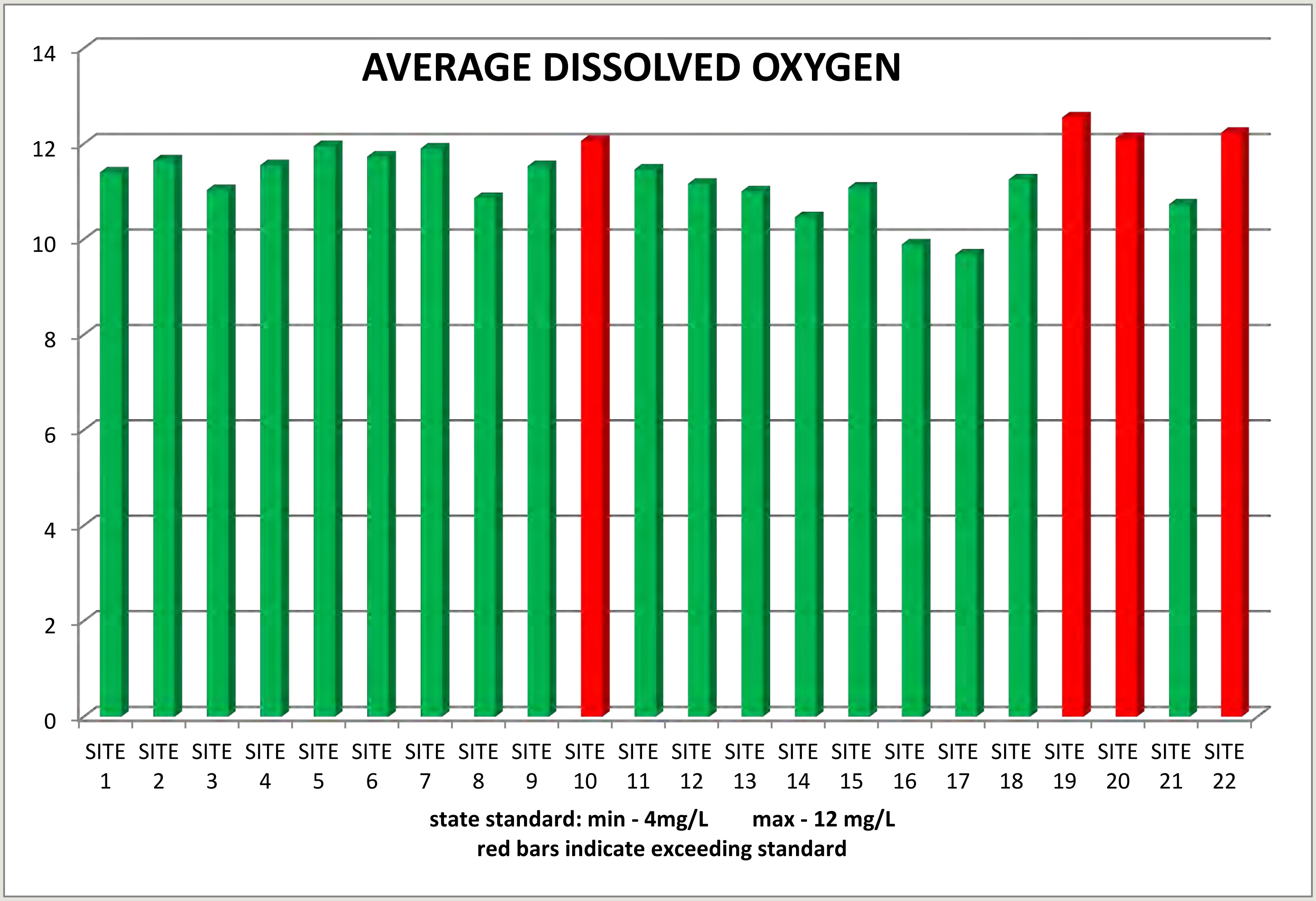


DISSOLVED OXYGEN (DO)
Dissolved oxygen (commonly abbreviated on forms as DO) found in water is essential to healthy streams and lakes. The dissolved oxygen measurement can indicate the level of pollution in the water is and how well the water can support aquatic plant and animal life. Generally, a higher dissolved oxygen level indicates better water quality. If dissolved oxygen levels are too low, some fish and other organisms may not be able to survive.

Much of the dissolved oxygen in water comes from oxygen in the air that has dissolved in the water. Some of the dissolved oxygen in the water is a result of photosynthesis of aquatic plants. Stream turbulence may also increase dissolved oxygen levels when air is trapped under rapidly moving water, dissolving the oxygen into the water. In addition, the amount of oxygen that can dissolve in water depends on temperature. Colder water can hold more oxygen than warmer water. Similarly, a difference in dissolved oxygen levels may be apparent at different depths of the water if there is a significant change in water temperature.

There are several reasons why a stream may have low dissolved oxygen. Temperature, turbulence, and the time the sample was taken could all contribute to the reading. Pollution may also have an impact. Similar to biological oxygen demand, dissolved oxygen is impacted by the same types of nonpoint sources and flow regimes.

Figure 35: Average Dissolved Oxygen

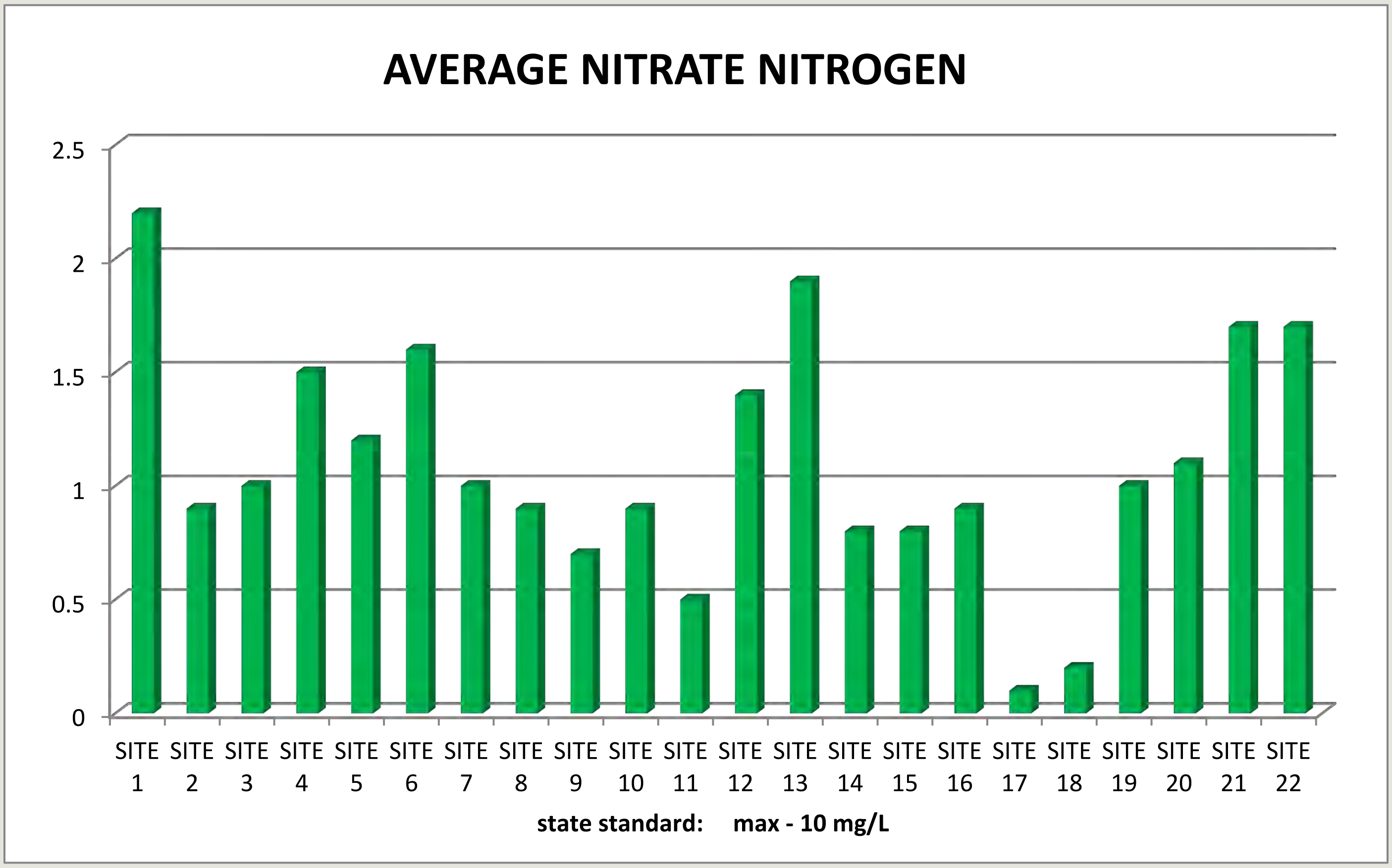


NITRATE + NITRITE

Nitrate - Nitrates can have the same effect on the water system as phosphorus, only to a much lesser degree. Nitrates can be found at levels up to 30 mg/L in some waters before detrimental effects on aquatic life occur. However, due to the fact that infants who consume water with nitrate levels exceeding the US EPA MCL of 10 mg/L can become ill, nitrates in drinking water should be of particular concern to people who use wells as their drinking water source. The most common sources of nitrates are from fertilizer runoff from row crop fields, faulty septic systems, and sewage. The IKW steering committee has decided to use the US EPA reference level for nitrates in the water system, which is set at 1.5 mg/L.

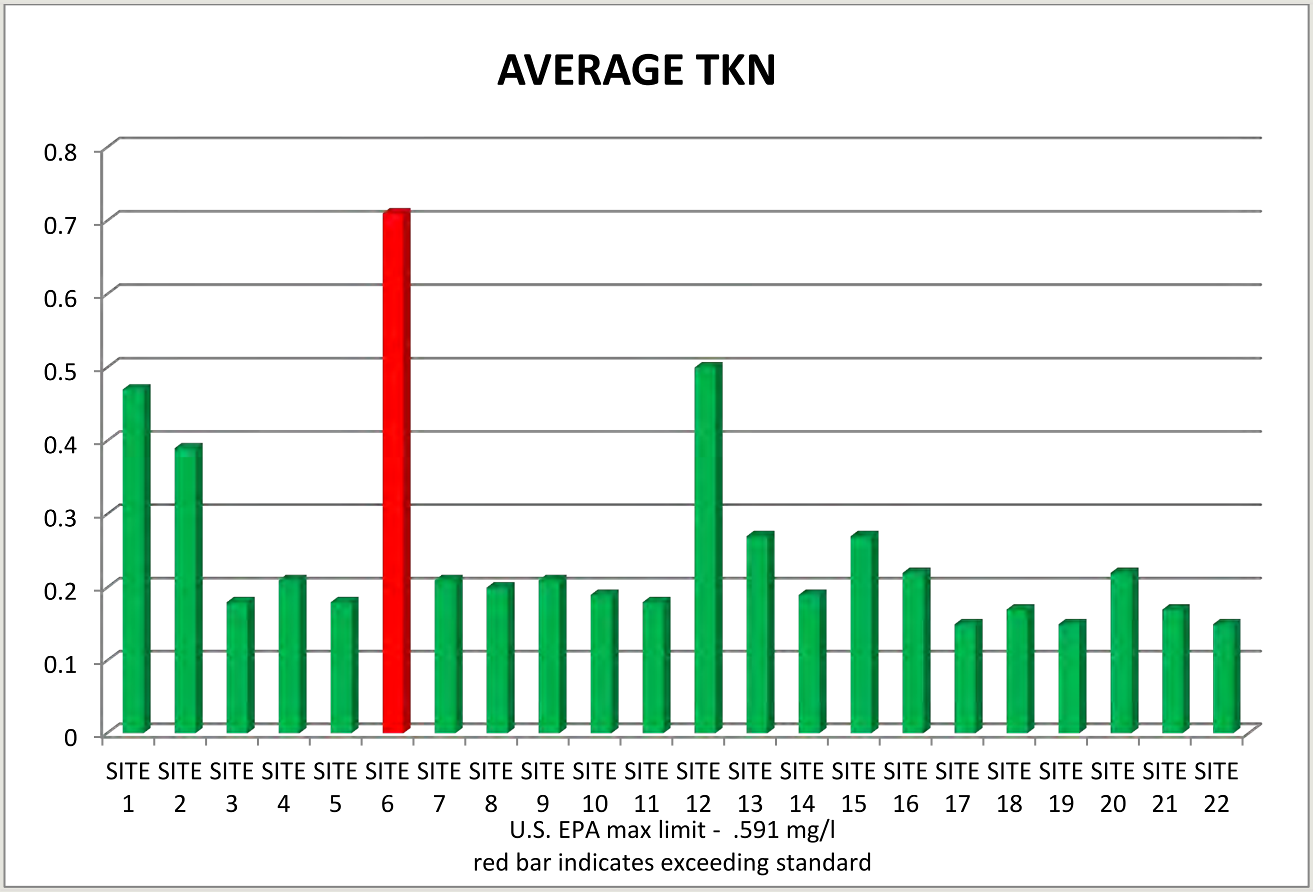
Nitrite - Nitrites are highly toxic to aquatic life and also toxic to humans, especially babies, if consumed in excessive amounts. Nitrites can cause shortness of breath and blue baby syndrome, which can lead to death in babies which is of great concern to those individuals who acquire their drinking water from wells. Nitrites are commonly found in the water system in trace amounts because nitrite is quickly oxidized to nitrate. However nitrites can be introduced in excessive amounts from sewage treatment plants if the oxidation process is interrupted, from farm field runoff, animal feeding lot runoff, and faulty septic systems. For the harmful health effects mentioned above, the state of Indiana adopted the US EPA MCL standard of less than 1 mg/L of nitrite in drinking water which can be found in 327 IAC 2-1-6.

Figure 36: Average Nitrate Nitrogen



TOTAL KJELDAHL NITROGEN (TKN)
TKN measures the sum of ammonia and organic nitrogen in water. An abundance of nutrients in water leads to excess plant growth and eventually to eutrophication.

Figure 37: Average TKN



pH

The pH level is a measure of the acidity in the water. pH levels that are too low or too high can have harmful effects on aquatic organisms. Most aquatic life needs a minimum pH of 6 to survive. The pH values of all test sites within the Indian-Kentuck Watershed fell within levels suitable for most freshwater aquatic life.

Figure 38: pH Range Impact

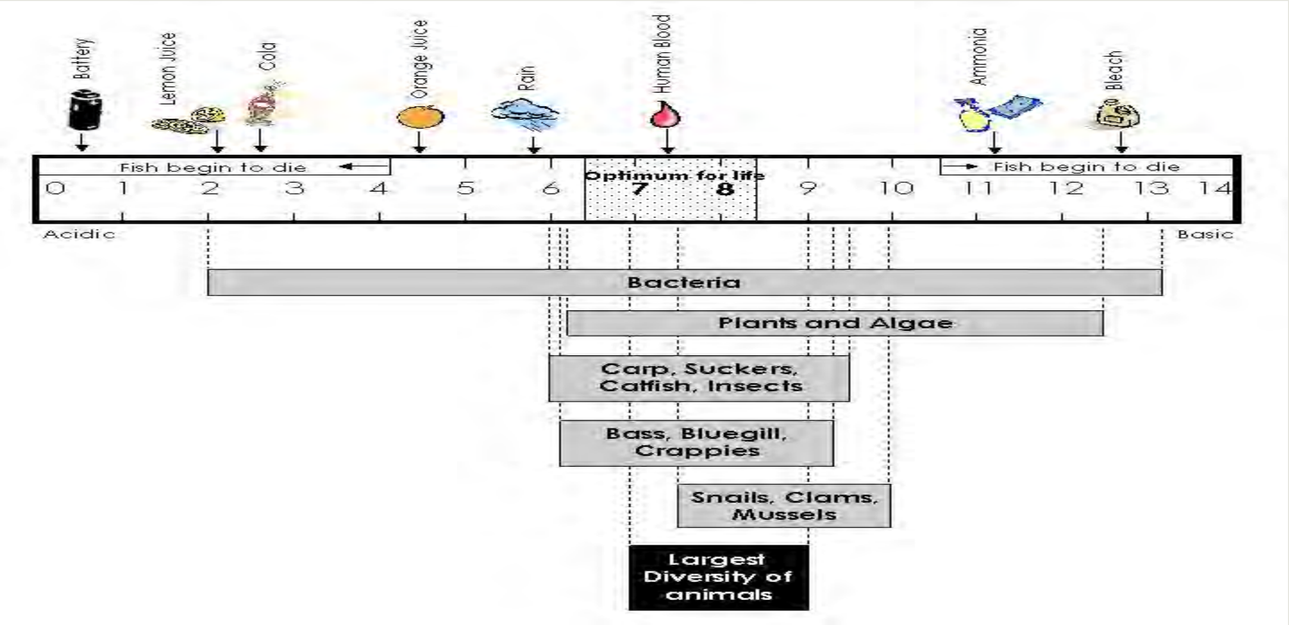
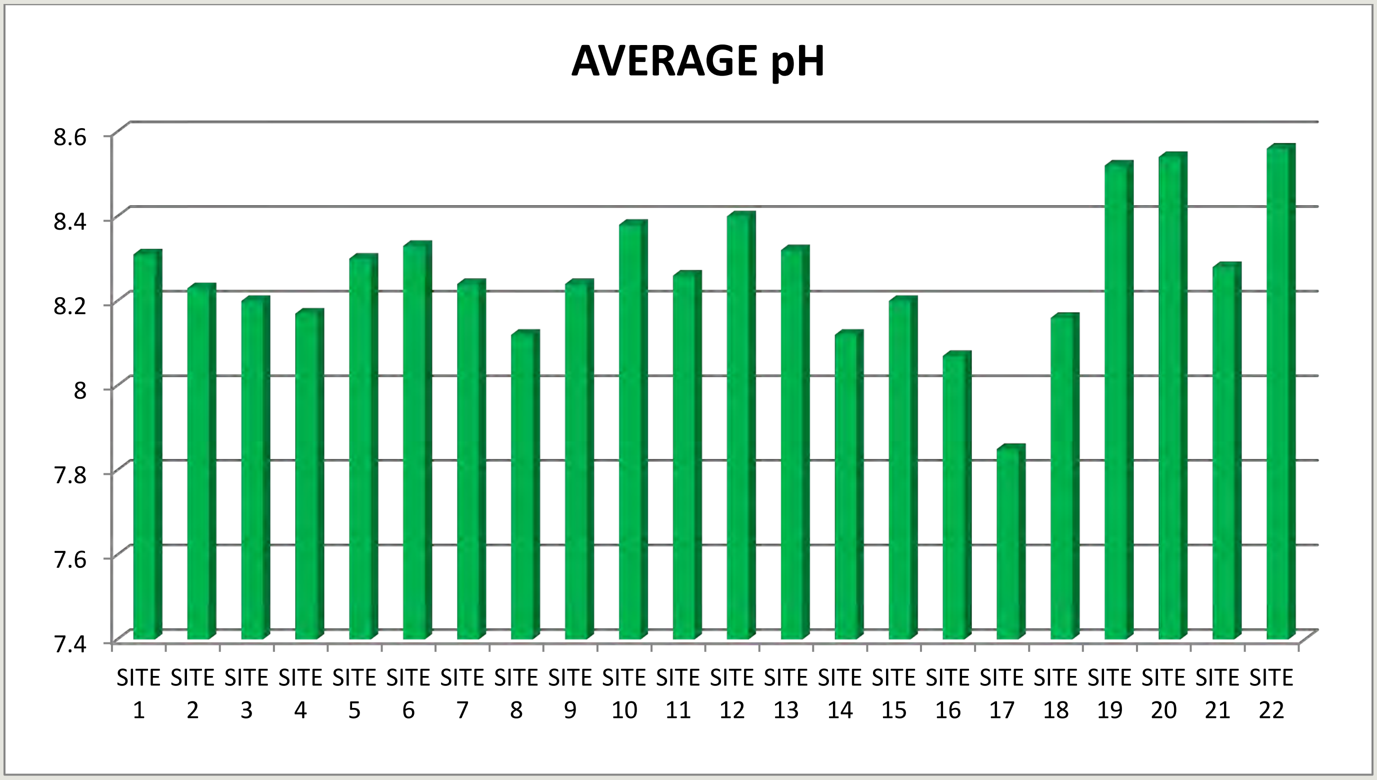


Figure 39: Average pH



TOTAL PHOSPHORUS
Phosphorus is usually present in natural waters as phosphate. Phosphates are present in fertilizers and laundry detergents and can enter the water from agricultural run-off, industrial waste and sewage discharge. Phosphates, like nitrates, are plant nutrients. When too much phosphate enters the water, plant growth flourishes.

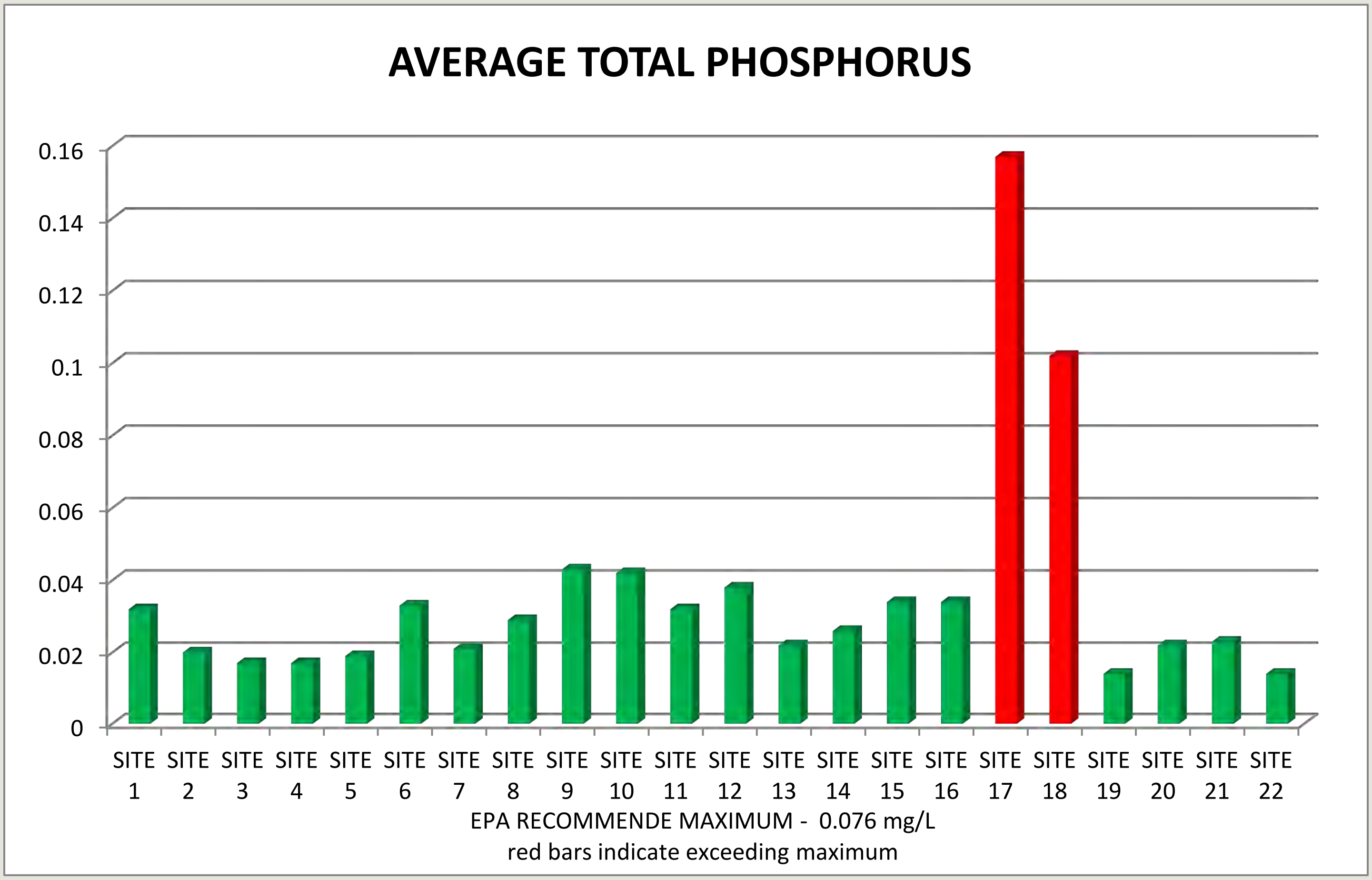
Phosphates also stimulate the growth of algae which can result in an algae bloom. These large plant populations produce oxygen in the upper levels of the water. When the plants die and fall to the bottom they are decomposed by bacteria, consuming much of the dissolved oxygen in the lower levels. Bodies of water with high levels of phosphates usually have high biological oxygen demand (BOD) levels and subsequent low dissolved oxygen levels.

- *Ortho-Phosphate* is a dissolved form of phosphorus. Sources can include failing septic systems, animal waste, fertilizers, decaying plants and animals and resuspension from the substrate.

- *Total Phosphorus* is a measurement that includes ortho-phosphate and undissolved forms of phosphorus. As phosphorus attaches to soil, the primary source of particulate phosphorus is soil loss or erosion from the land. Total phosphorus is often a problem in agricultural watersheds.

Sites 17 and 18 exceeded maximum recommended levels set by U.S. EPA. All other sites were below maximum recommended levels.

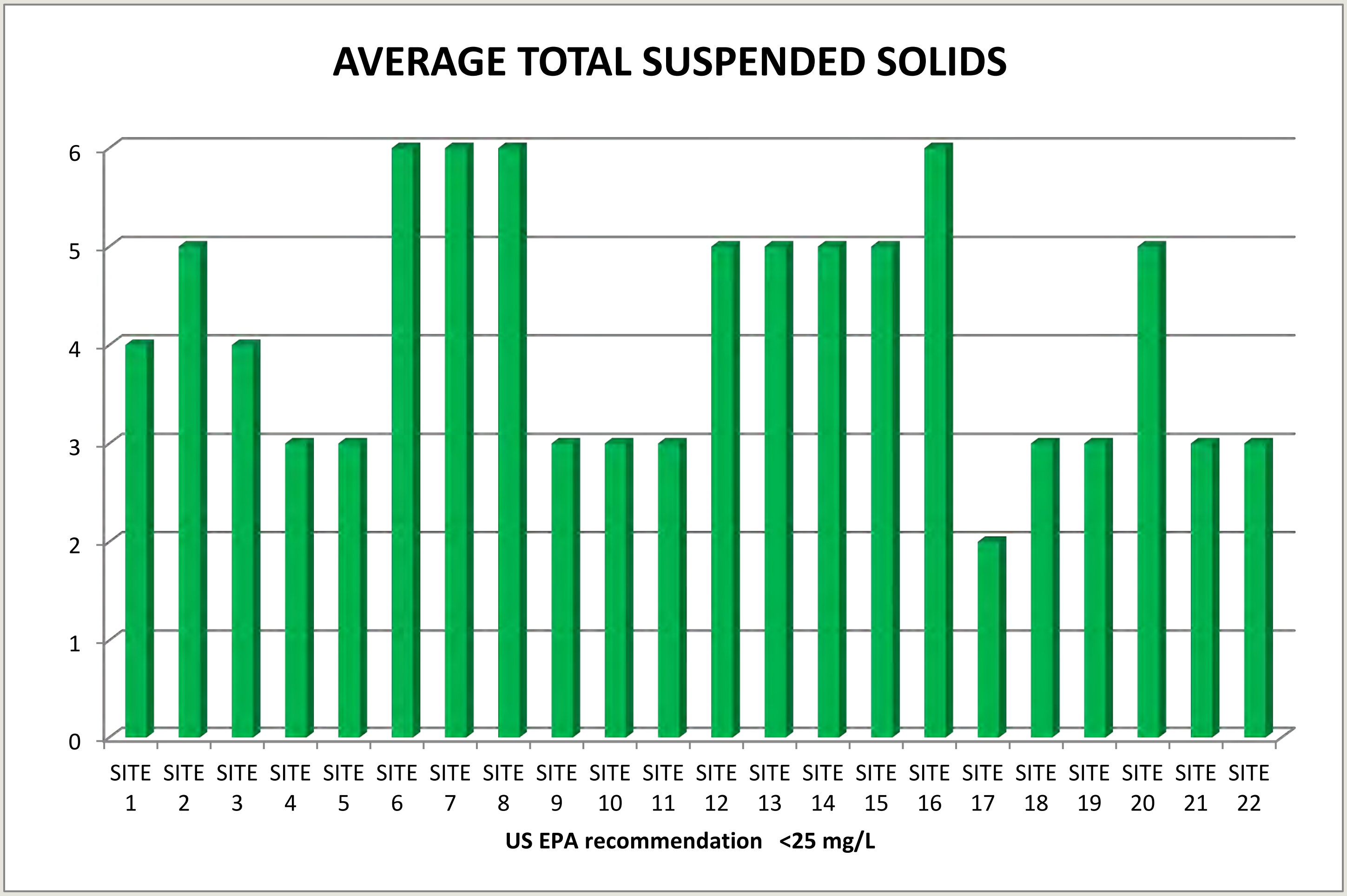
Figure 40: Average Total Phosphorus



TOTAL SUSPENDED SOLIDS

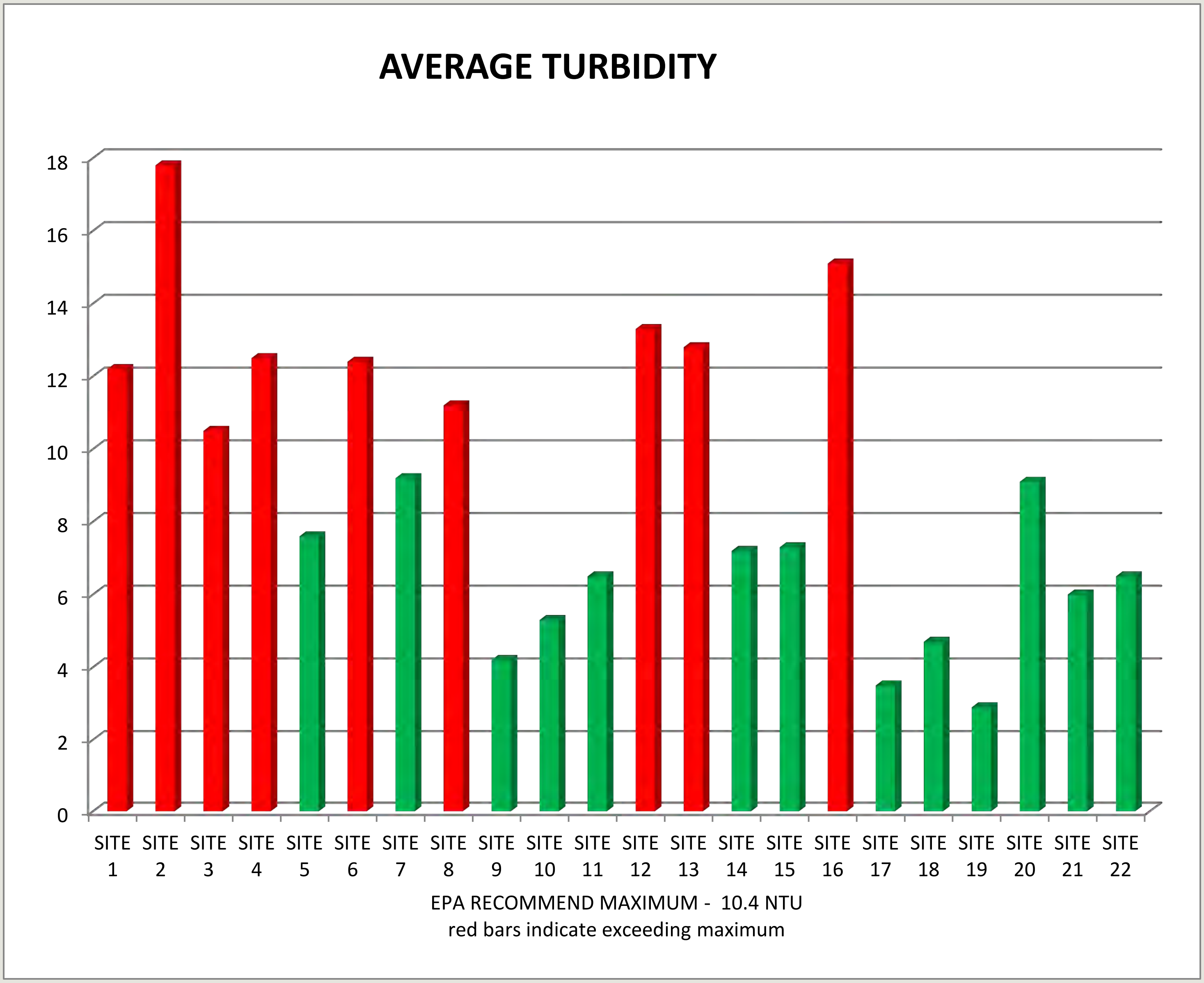
Total Suspended Solids (TSS) includes all particles suspended in water that can be trapped by a filter. Although it's commonly collected to estimate the scale of sediment run-off from the watershed, TSS includes much more than just soil. TSS can include inorganic materials like industrial waste, and organic materials like dead plants and animal matter, live organisms and sewage. Large amounts of TSS can reduce water clarity, reduce light availability necessary for plant growth, and harm fish and other aquatic organisms. Sediment can clog fish gills and fill in spawning and other habitat areas. High TSS can also cause an increase in water temperature as the particles trap heat from the sun. Additionally, high TSS measurements can indicate high levels of nutrients, bacteria, metals and other chemicals since many of these pollutants attach to sediment. TSS even has an economic impact, since it has to be filtered out of surface water used as a drinking water source.

Figure 41: Average Total Suspended Solids



TURBIDITY
Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. Turbidity is measured in NTUs: nephelometric turbidity units. The instrument used for measuring it is called nephelometer or turbidimeter, which measures the intensity of light scattered at 90 degrees as a beam of light passes through a water sample. In lakes turbidity is measured with a secchi disk. This black and white disk is dropped in the water attached to a rope. The depth that the disk reaches before it disappears from sight is recorded. This provides an estimation of the turbidity level in the lake. Sources of turbidity are similar to total suspended solids (TSS).

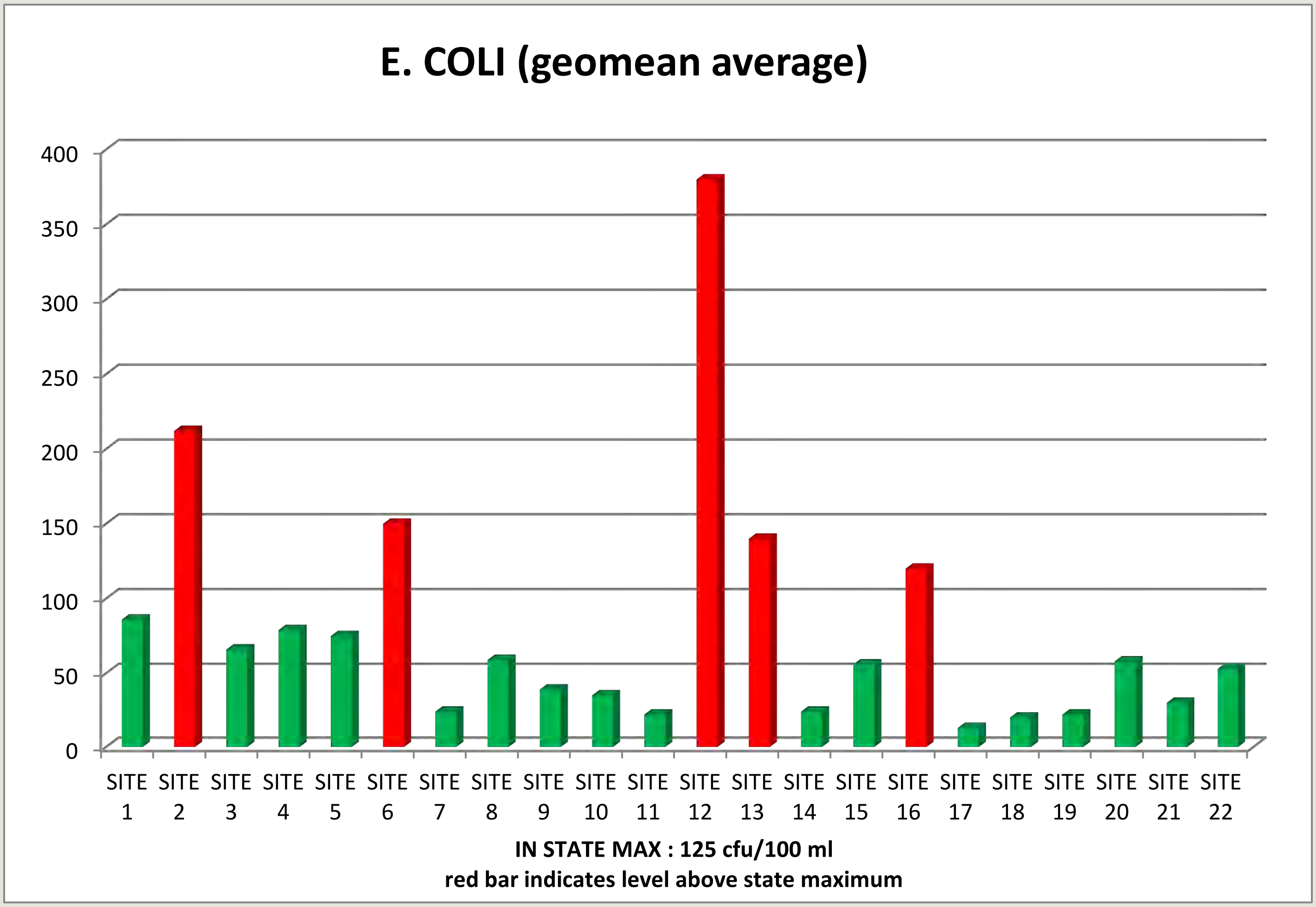
Figure 42: Average Turbidity



E.COLI

Escherichia coli (*E. coli*) are one member of a group of bacteria known as fecal coliform bacteria. An easy and economical bacteria to test for, *E. coli* is used as an indicator organism to identify the potential for the presence of pathogenic organisms in a water sample. Pathogenic organisms can present a threat to human health by causing a variety of serious diseases, including infectious hepatitis, typhoid, gastroenteritis, and other gastrointestinal illnesses. *E. coli* can come from the feces of any warm-blooded animal. Wildlife, livestock and domestic animal defecation, as well as manure fertilizers, previously contaminated sediments, combined sewer overflows, and failing or improperly sited septic systems are common sources of the bacteria. *E. coli* pollution found between rain events may signal issues that may need to be addressed.

Figure 43: E. coli (geomean average)



OTHER DATA:

Online research did not reveal any additional historical information of Indian Kentuck Watershed

LANDUSE

Landuse within the Indian Kentuck Watershed is used in various ways. The majority of landuse in woodland (65%), while cultivated cropland (15%) and pasture / hayland (11%) make up most of the remainder. The following charts show specific landuse acreage in each subwatershed.

Figure 44: Landuse Chart Sub-Unit 051401010201 (Vestal Branch)

LANDUSE SUB-UNIT 051401010201	ACRES	% OF SUB-UNIT
Cultivated Crops	5037.76	45.84
Developed, High Intensity	1.49	0.01
Developed, Low Intensity	24.89	0.23
Developed, Medium Intensity	0.85	0.01
Developed. Open Space	343.6	3.13
Forest	4731.42	43.06
Grassland / Herbaceous	50.19	0.46
Open Water	23.41	0.21
Pasture / Hay	771.97	7.02
Shrub / Scrub	1.33	0.01
Wetlands	1.95	0.02
Total	10988.86	

Figure 45: Landuse Graph Sub-Unit 051401010201

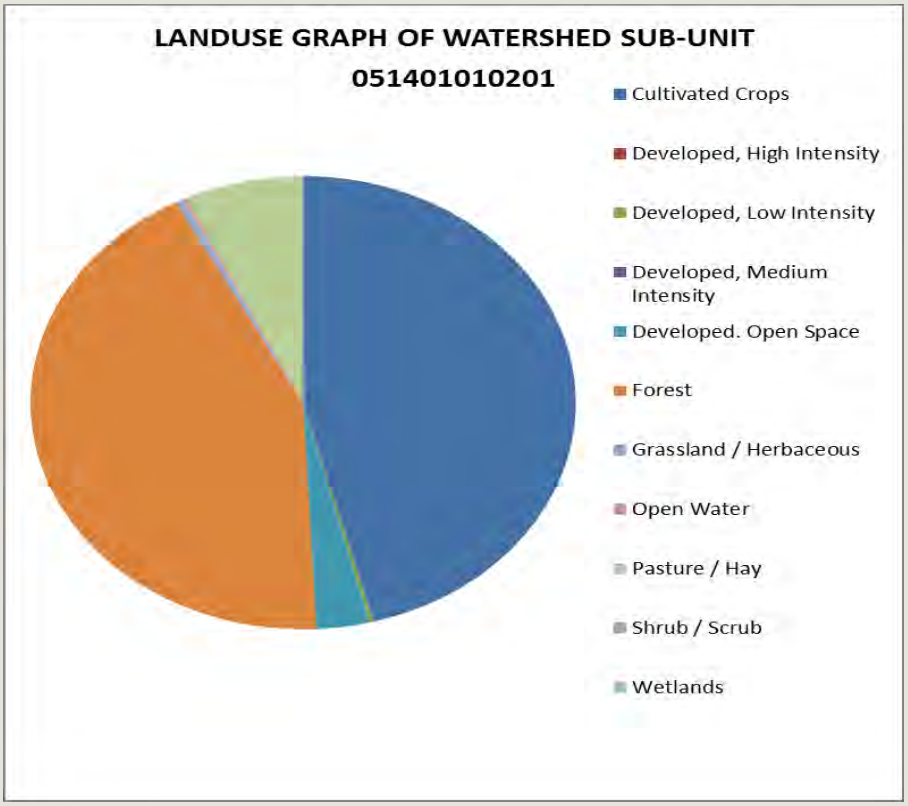


Figure 46: Landuse Chart Sub-Unit 051401010202 (Wilson Fork)

LANDUSE SUBUNIT 051401010202	ACRES	% OF SUB-UNIT
Cultivated Crops	2086.42	17.76
Developed, High Intensity	1.23	0.01
Developed, Low Intensity	14.50	0.12
Developed, Medium Intensity	13.74	0.12
Developed. Open Space	372.90	3.17
Forest	7719.81	65.69
Grassland / Herbaceous	278.17	2.37
Open Water	67.66	0.58
Pasture / Hay	1190.39	10.13
Shrub / Scrub	1.73	0.01
Wetlands	5.09	0.04
Total	11751.59	

Figure 47: Landuse Graph Sub-Unit 051401010202

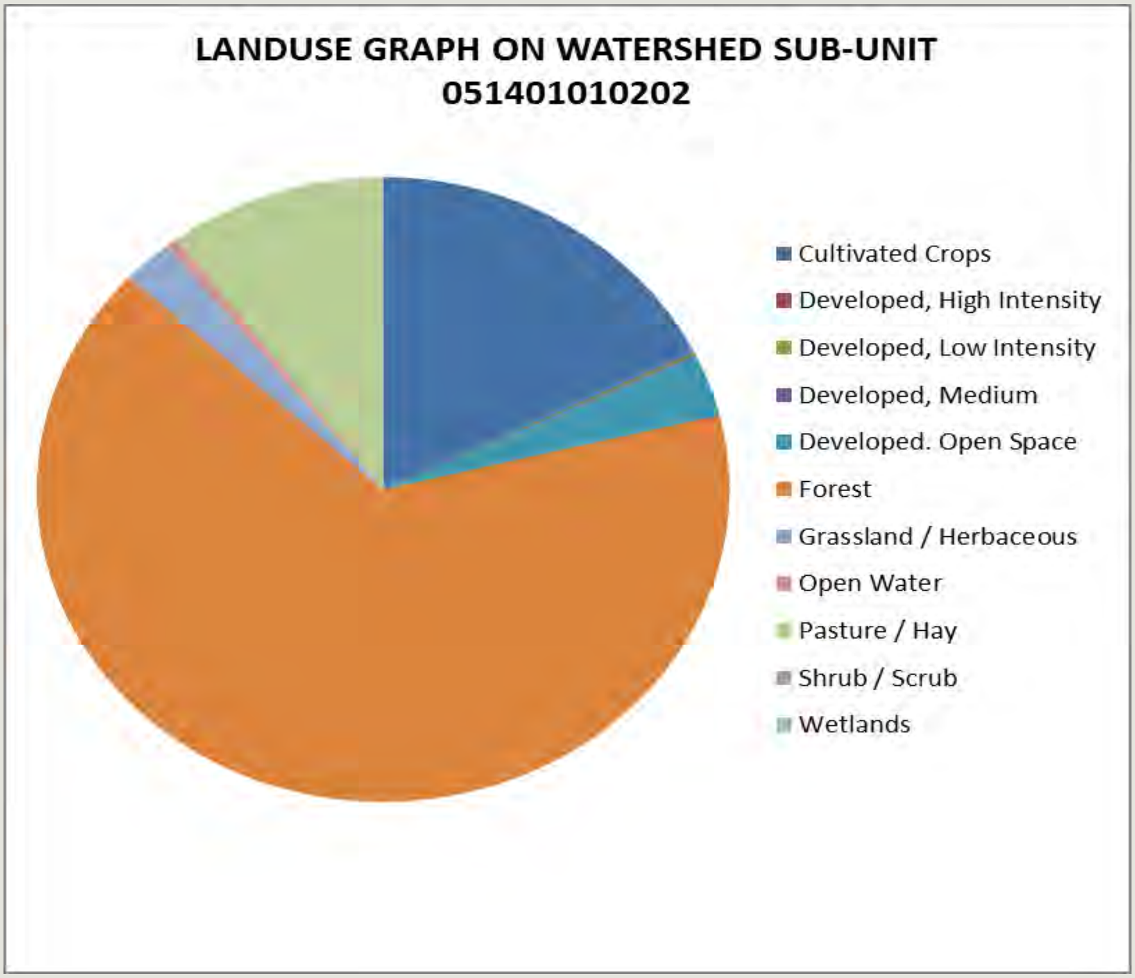


Figure 48: Landuse Chart Sub-Unit 051401010203 (Headwaters West Fork Indian Kentuck)

LANDUSE SUBUNIT 051401010203	ACRES	% OF SUB-UNIT
Cultivated Crops	3595.94	31.47
Developed, High Intensity	1.18	0.01
Developed, Low Intensity	29.49	0.26
Developed, Medium Intensity	1.08	0.01
Developed. Open Space	384.10	3.36
Forest	6069.31	53.12
Grassland / Herbaceous	145.85	1.28
Open Water	23.66	0.21
Pasture / Hay	1173.33	10.27
Shrub / Scrub	0.88	0.01
Wetlands	0.89	0.01
Total	11425.71	

Figure 49: Landuse Graph Sub-Unit 051401010203

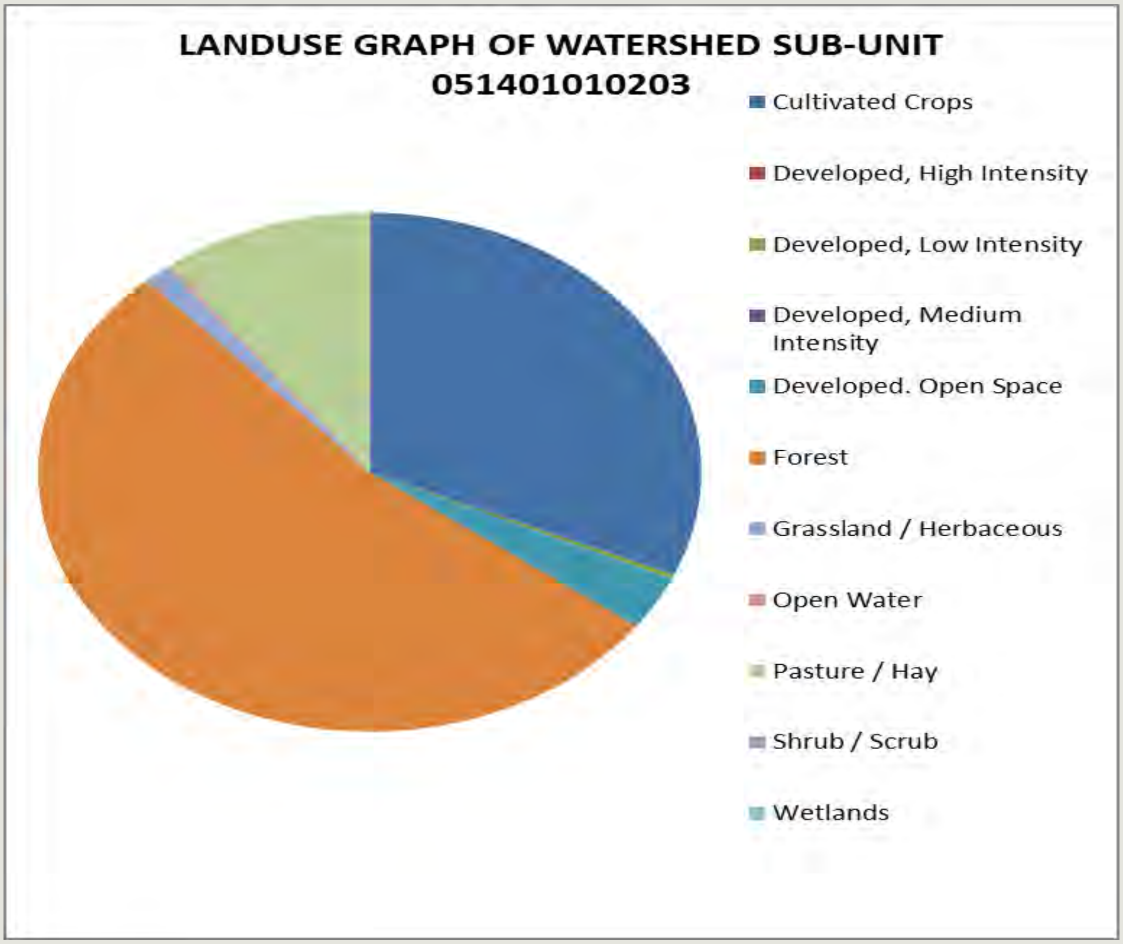


Figure 50: Landuse

Chart Sub-Unit 051401010204 (West Fork Indian Kentuck)

LANDUSE OF SUB-UNIT 051401010204	ACRES	% OF SUB-UNIT
Cultivated Crops	2148.29	11.29
Developed, High Intensity	1.32	0.01
Developed, Low Intensity	34.50	0.19
Developed, Medium Intensity	4.00	0.02
Developed. Open Space	653.70	3.63
Forest	11769.72	65.32
Grassland / Herbaceous	678.28	3.76
Open Water	13.60	0.08
Pasture / Hay	2696.90	14.97
Shrub / Scrub	5.10	0.03
Wetlands	13.66	0.08
Total	18019.07	

Figure 51: Landuse Graph Sub-Unit 051401010204

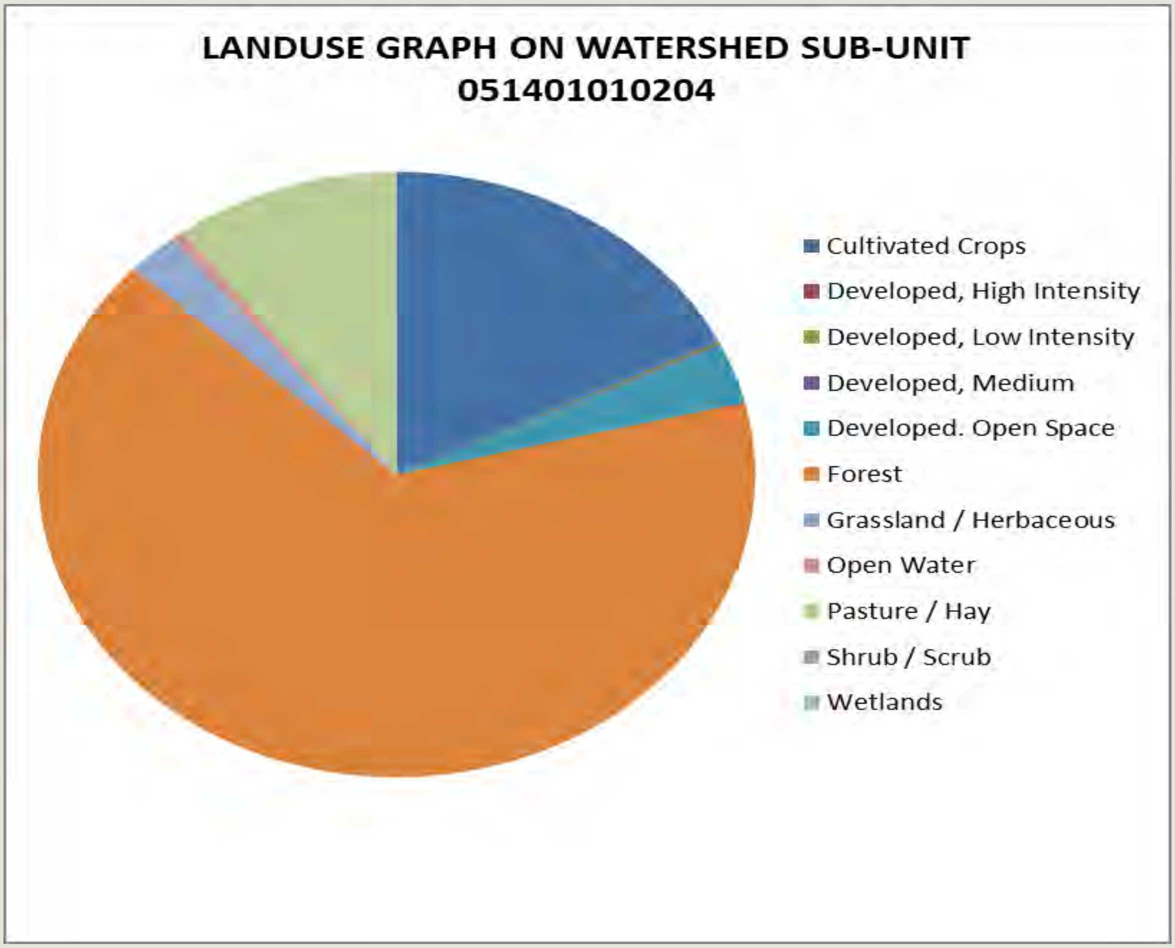


Figure 52: Landuse Chart Sub-Unit 051401010205 (Brushy Fork)

LANDUSE SUB-UNIT 051401010205	ACRES	% OF SUB-UNIT
Cultivated Crops	1915.49	7.42
Developed, High Intensity	0	0.0
Developed, Low Intensity	10.07	0.04
Developed, Medium Intensity	7.95	0.03
Developed. Open Space	718.03	2.78
Forest	18166.60	70.33
Grassland / Herbaceous	1421.52	5.50
Open Water	38.93	0.15
Pasture / Hay	3506.40	13.57
Shrub / Scrub	4.25	0.02
Wetlands	41.55	0.16
Total	25830.77	

Figure 53: Landuse Graph Sub-Unit 051401010205

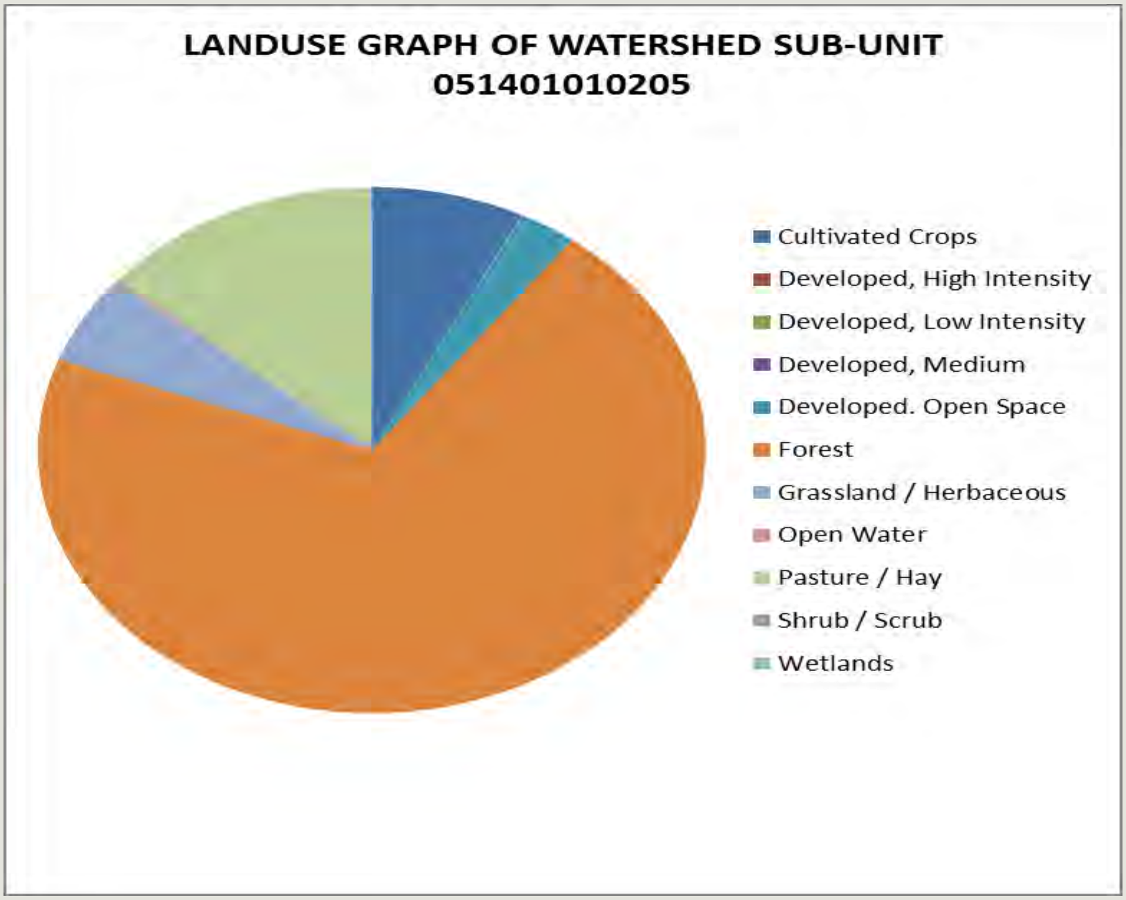
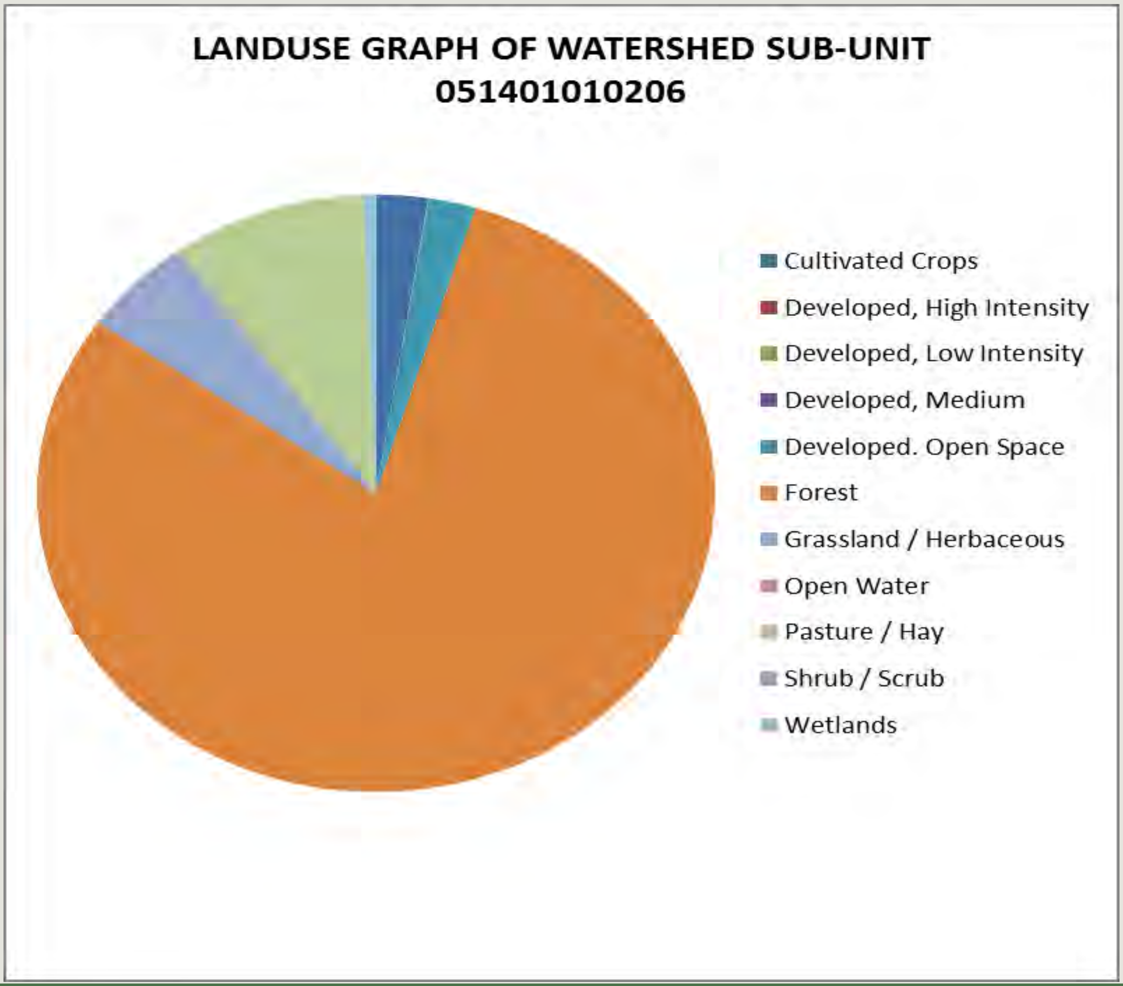


Figure 54: Landuse Chart Sub-Unit 051401010206 (Doe Run)

LANDUSE SUB-UNIT 051401010206	ACRES	% OF SUB-UNIT
Cultivated Crops	488.77	2.47
Developed, High Intensity	.05	0.01
Developed, Low Intensity	7.89	0.04
Developed, Medium Intensity	1.79	0.01
Developed. Open Space	442.63	2.23
Forest	15811.99	79.94
Grassland / Herbaceous	1046.57	5.29
Open Water	27.25	0.14
Pasture / Hay	1834.57	9.27
Shrub / Scrub	6.06	0.03
Wetlands	110.64	0.56
Total	19779.84	

Figure 55: Landuse Graph Sub-Unit 051401010206



LANDUSE SUMMARY

As shown in the landuse charts the majority of landuse is in woodland (65%), while cultivated cropland (15%) and pasture / hayland (11%) make up most of the remainder. Due to the recent economic downturn there is no indication of a landuse trend change and residential site development has slowed. Development and industrial use within this watershed is not currently practical due to the lack of infrastructure.

There are stream banks in need of stabilization within the watershed but the exact number and location are not known due to the information not being feasible to collect during the visual survey. However, stakeholders have made mention of stream bank erosion on their property during steering committee meetings.

Within the watershed there are 3 leaking underground storage tanks located in the watershed subunit of Vestal Branch. This information was obtained from IDEM's list of "Leaking Underground Storage Tanks".

The Indian Kentuck Watershed area is primarily rural in nature therefore the use of fertilizers and pesticides in residential urban settings are essentially nonexistent. However, fertilizer and pesticide use for agricultural purposes are a concern, especially when 59.6% of the watershed has soils classified at HEL by NRCS.

There are several hobby farms in the watershed that typically have a few head of cattle and/or horses on smaller acreage. This situation can lead to overgrazing and soil erosion causing water quality degradation. The subunits of Doe Run, Brushy Fork, and West Fork seem to have the largest concentration of hobby farms. According to data obtained from EPA's STEPL model the subunits of Wilson Fork, Vestal Branch, and Headwaters West Fork have the largest number of swine feeding operations, while Doe Run, Brushy Fork, and West Fork have the highest concentration of cattle.

While 65% of the watershed is in woodland, resource issues for this landuse is limited primarily to livestock in the woods causing soil erosion and sedimentation.

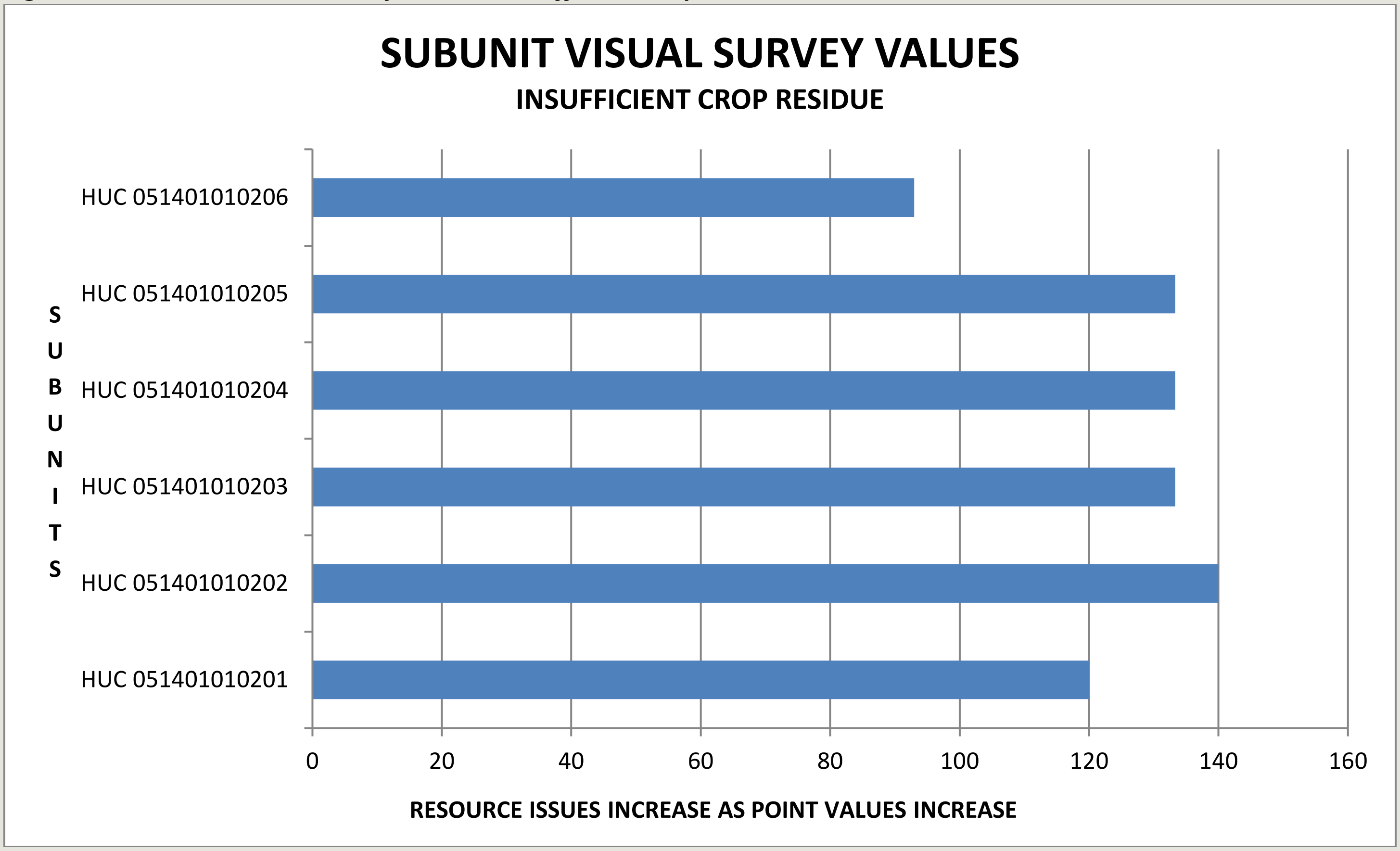
Cultivated cropland making up 15% of the watershed has issues relating to HEL soils, runoff of fertilizers and pesticides, insufficient residue cover, and negligible use of cover crops.

Pasture and hayland make up 11% of the watershed and has resource issues of overgrazing, inadequate stands and quality of forages, and lack of alternative watering systems.

VISUAL ASSESSMENT SUMMARY

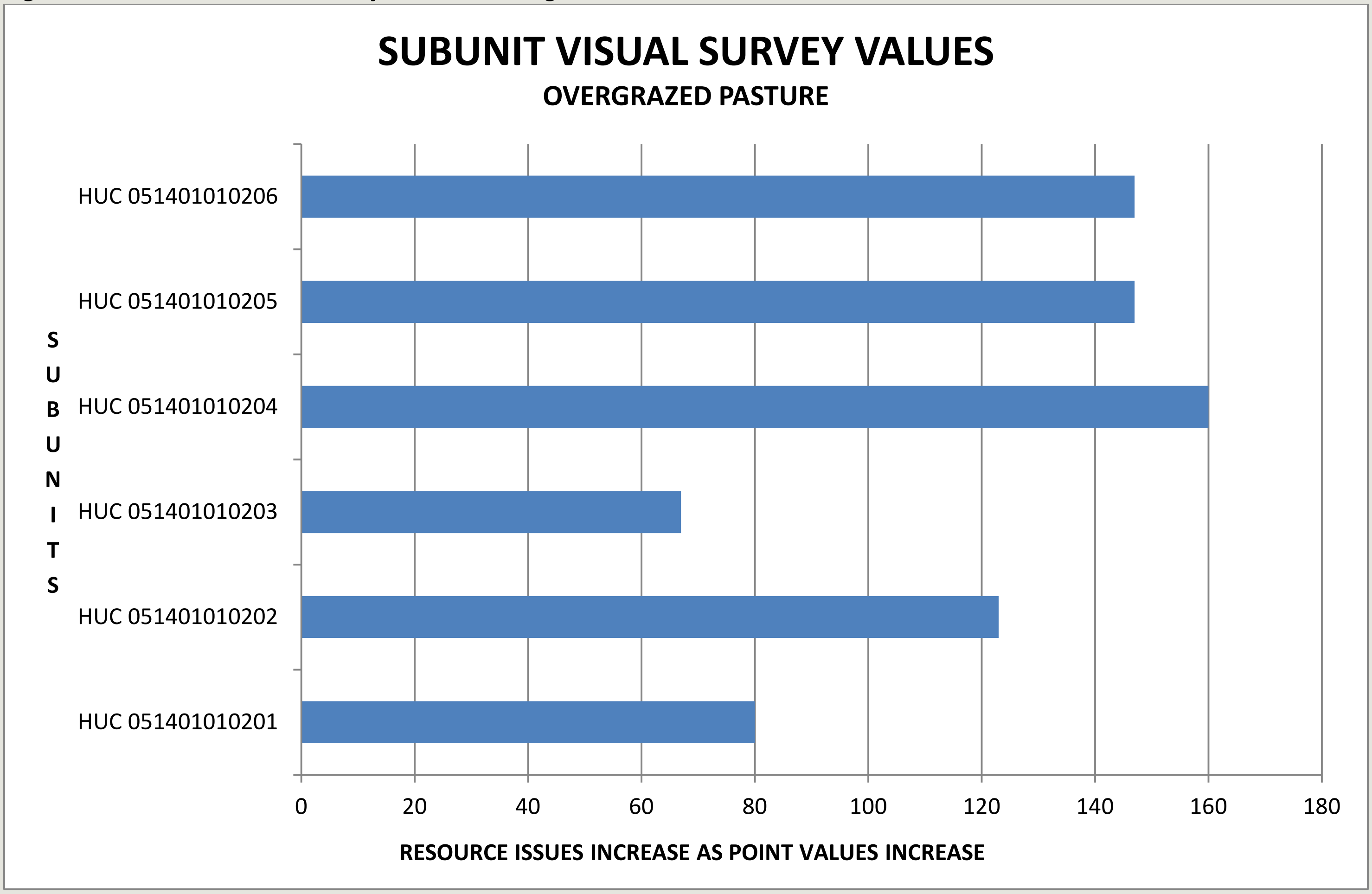
The watershed visual assessment conducted at 64 different sites within the Indian-Kentuck Watershed, evaluated resource conditions based on cropland residue, pasture/hayland conditions, livestock access to water, stream buffers, woodland conditions, septic, and trash issues. Each 12 digit watershed unit within the Indian –Kentuck watershed was assessed. The visual assessment criteria matches many of the stakeholder concerns identified early in the project. Concerns identified included too much conventional tillage, sedimentation from overgrazing, livestock in streams, etc. The visual assessment survey confirmed many of the concerns voiced by stakeholders. Below is the summary in graph form for each resource issue within each 12 digit HUC. The values shown in the chart are an average of the 3 visual surveys completed each year between 2010 and 2013.

Figure 56: Sub-Unit Visual Survey Values – Insufficient Crop Residue



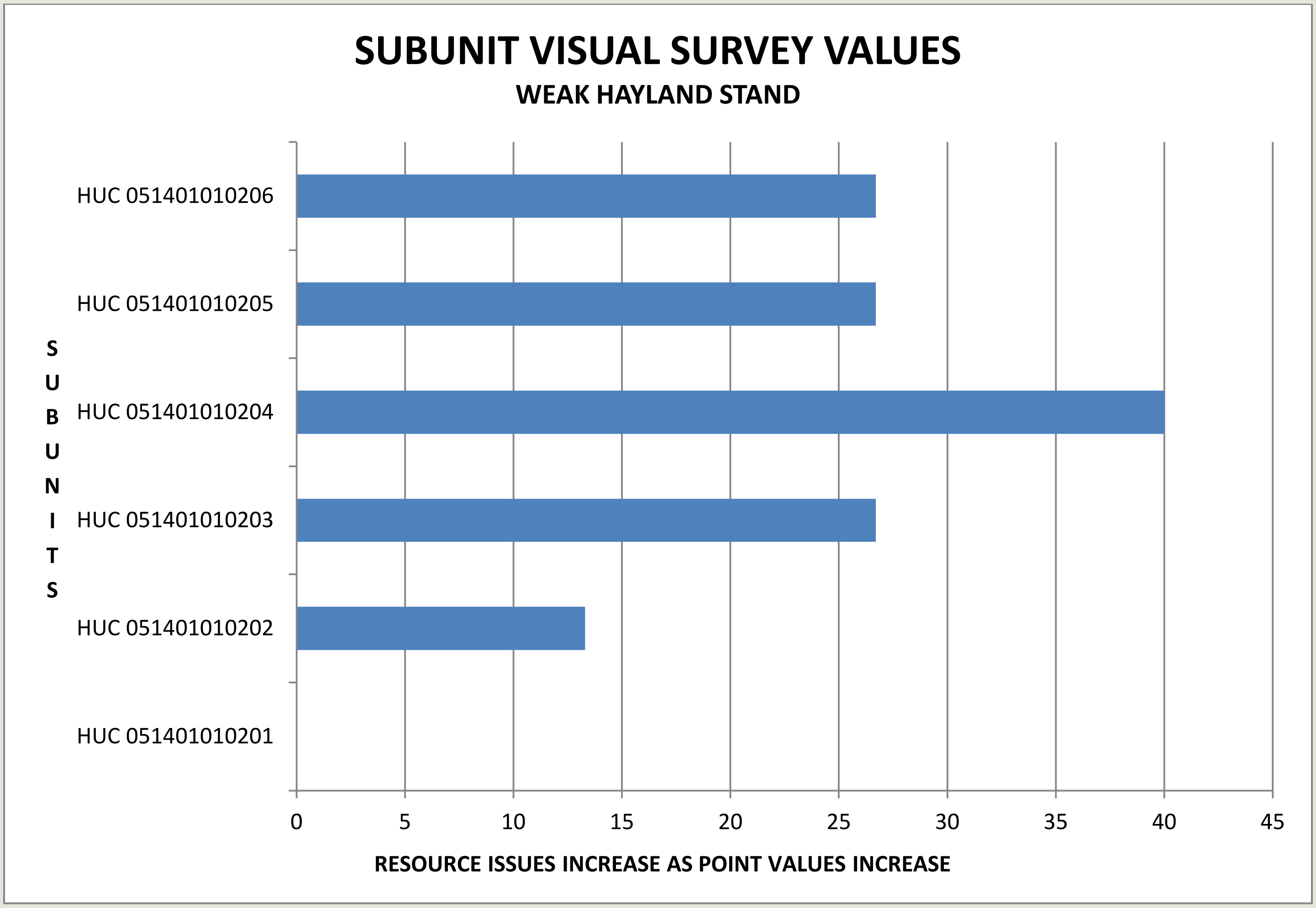
The insufficent crop residue survey indicates that insufficent residue amounts are a concern in subunits 051401010201, 051401010202, 051401010203, 051401010204, and 051401010205. These subunits make up approximately 14,781 acres of the 15,270 acres of cropland within the entire Indian-Kentuck Watershed. Residue amounts were a little higher in 051401010201 due to no-till and minimum tillage being used on many of the larger crop fields in this subunit. Stakeholder concerns tied to this resource issue include need for more cover crop on cropland, lack of grade stabilization structures, too much conventional tillage, and excessive gully erosion in cropland. There was also an educational component, “need for soils education involving compaction, cover crops and nitrogen fixation” identified by stakeholders.

Figure 57: Sub-Unit Visual Survey Values – Overgrazed Pasture



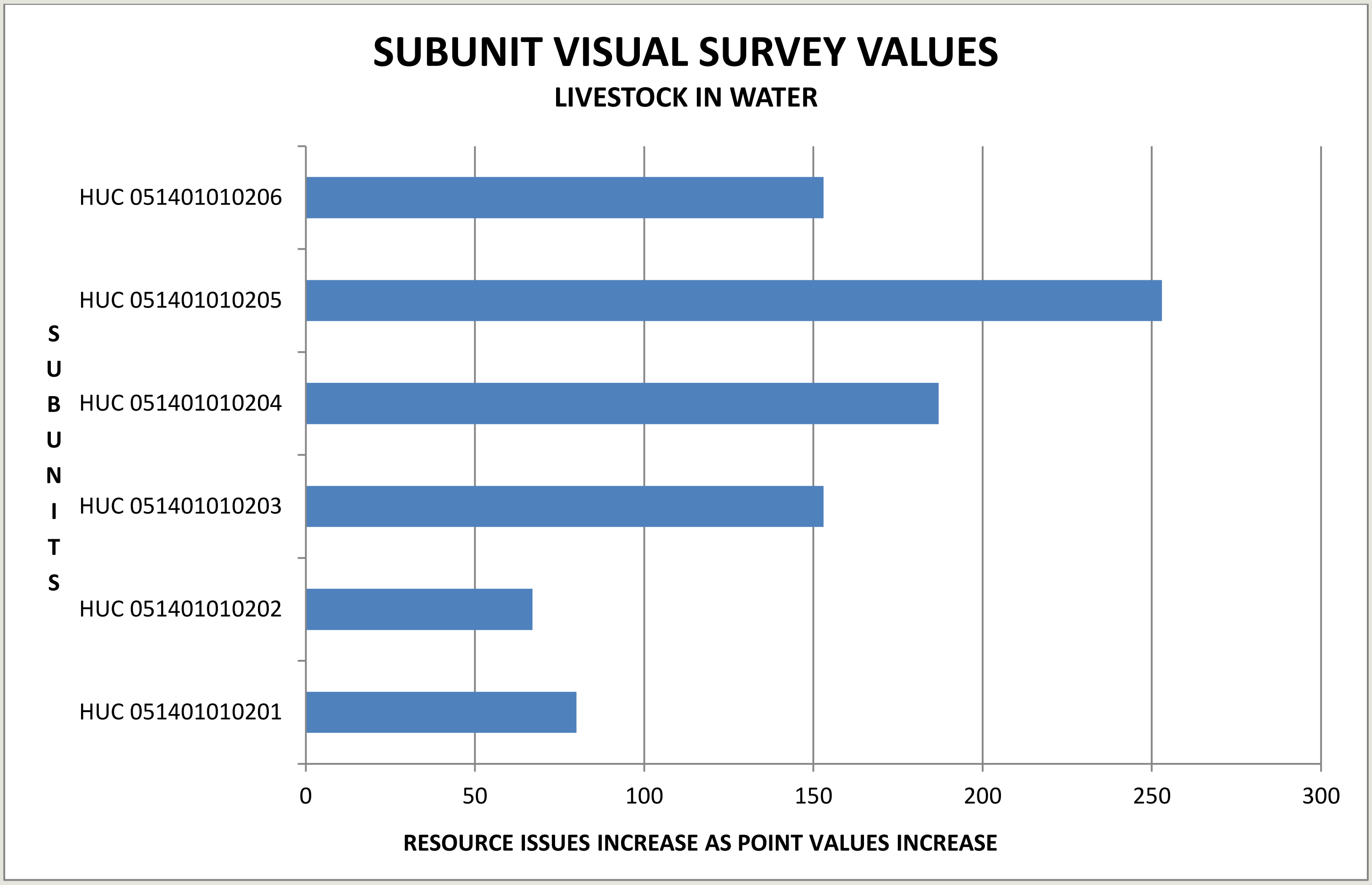
The overgrazed pasture visual survey indicated that subunits 051401010202, 051401010204, 051401010205, and 051401010206 have resource issues with overgrazed pastures. This could be due to overstocking of livestock in these pasture areas and also to soils within these areas being more rolling and moderately eroded making for droughty conditions during summer. This theory corresponds with the values of subunit 051401010203 which has a significant acreage (1173 ac.) of pasture land but does not have as high of value as the other subunits. The soils within this subunit are more gently rolling and are not as eroded, lending to better moisture conditions during dry periods. Overgrazed, gully erosion, and low quality plant species in pastures were identified as concerns by stakeholders. Visual survey results support those concerns.

Figure 58: Sub-Unit Visual Survey Values – Weak Hayland Stand



The weak hayland stand visual survey indicate that subunits 051401010203, 051401010204, 051401010205, and 051401010206 have minor resource issues that may affect water quality. These 4 subunits comprise 9209 acres of the total 11,171 acres of pasture / hayland. While these 4 subunits have higher values the overall condition of most hayland fields within the watershed had good grass cover that reduced sedimentation and were not detrimental to water quality. Weak hayland stands were not identified as a concern by statkeholders and the visual survey seems to support that position.

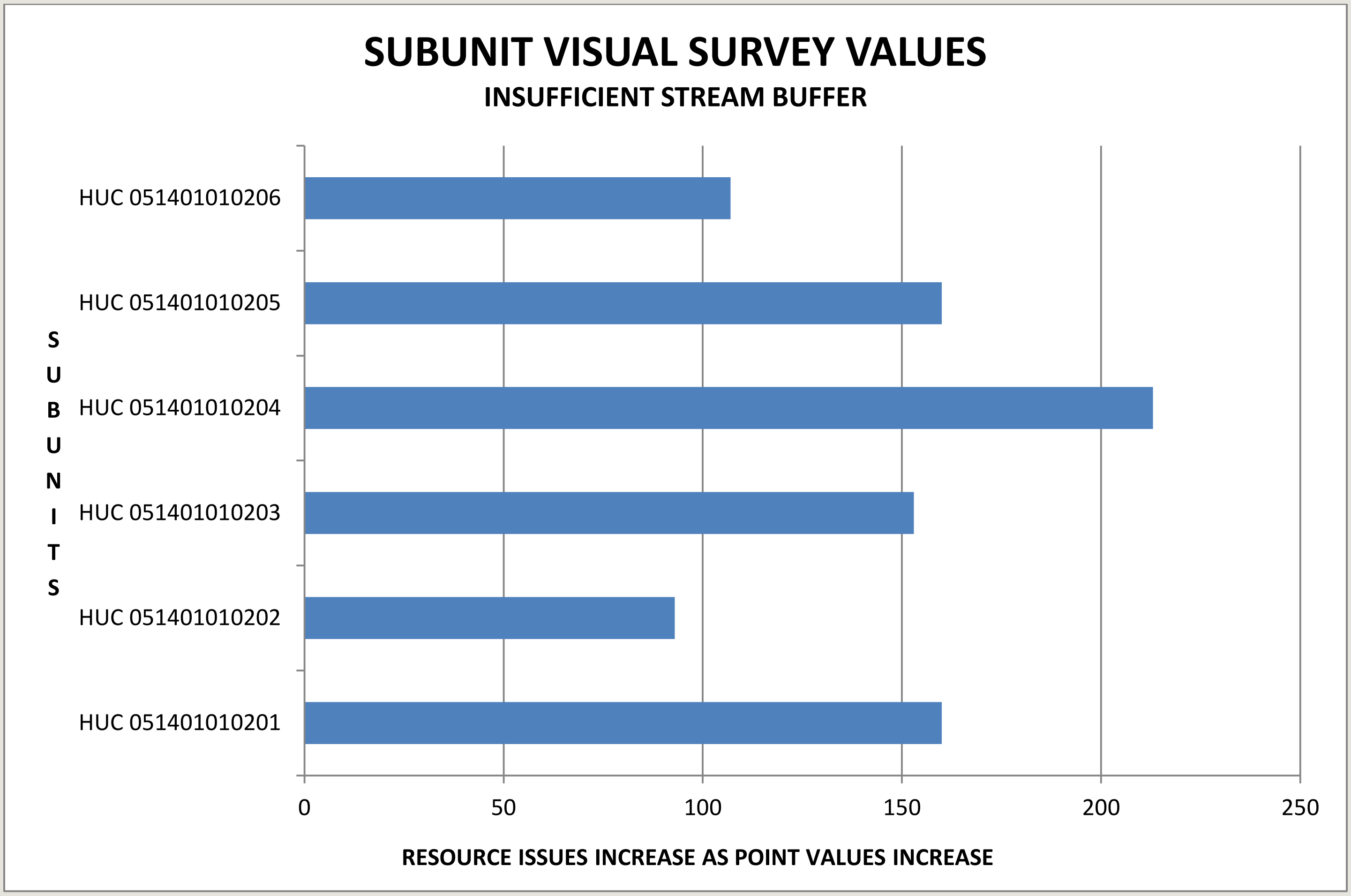
Figure 59: Sub-Unit Visual Survey Values – Livestock in Water



The visual survey results for livestock in water shows subunits 051401010204 and 051401010205 having issues. These results are understandable since the main branch of Indian-Kentuck is located in these subunits and landowners often use the stream for watering of livestock due to consistent water flow or pooling year round. It is interesting to note that the section of Indian-Kentuck designated as a 303(d) impairment by IDEM is located in the main branch of these 2 subunits.

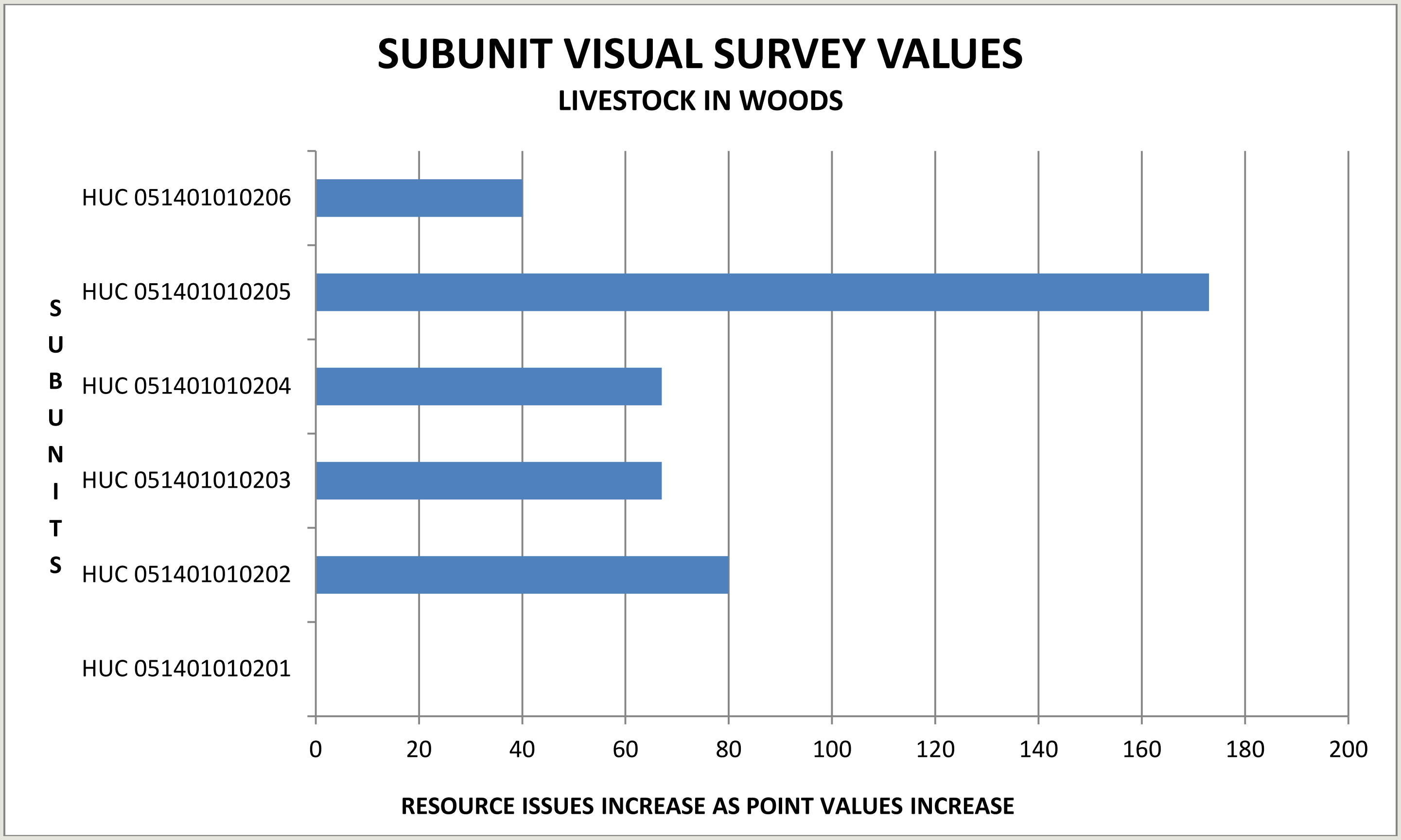
The subunits of 051401010203 and 051401010206 also had cattle with access to water but to a lesser degree, as did subunits 051401010201 and 051401010202.

Figure 60: Sub-Unit Visual Survey Values – Insufficient Stream Buffer



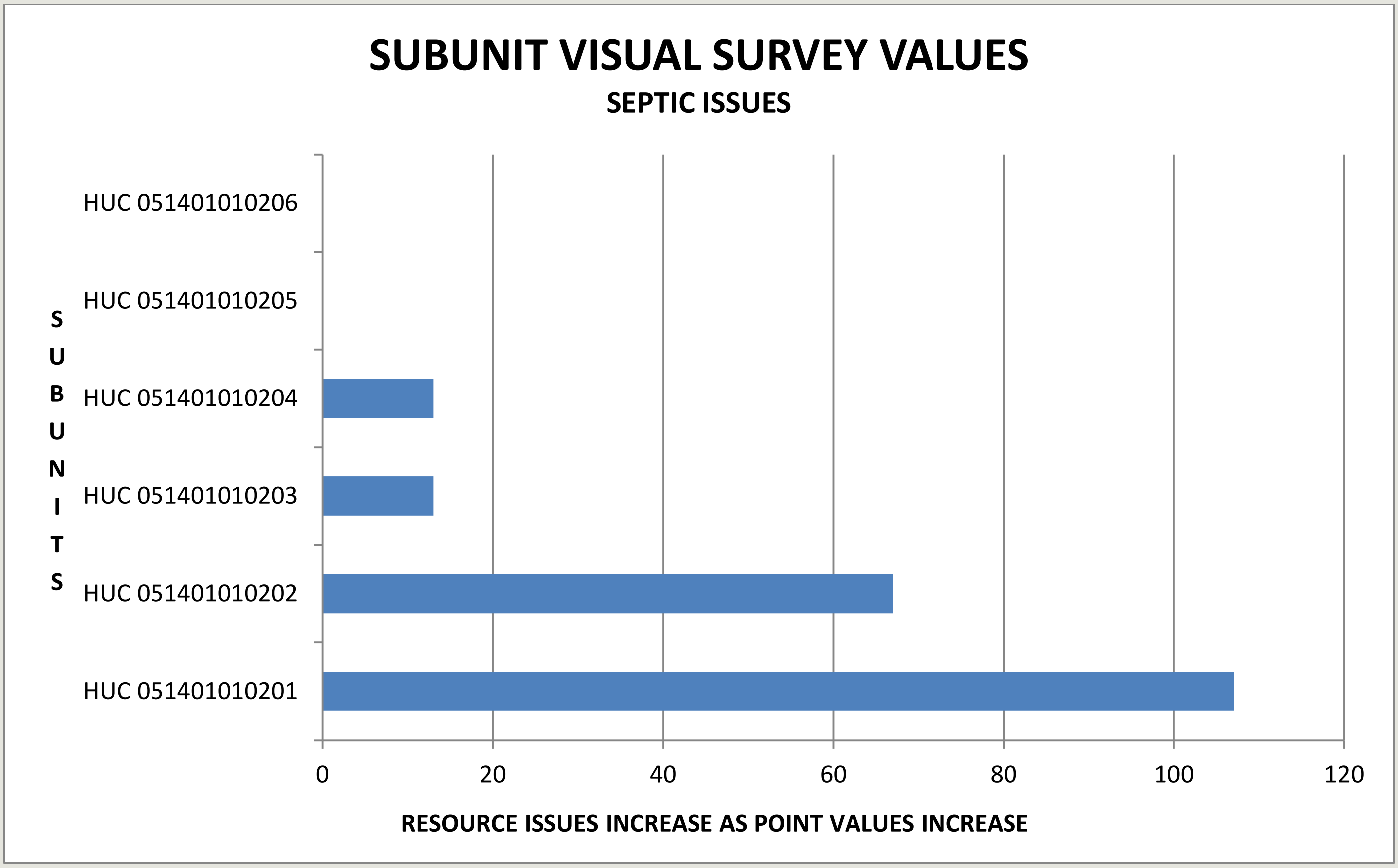
The visual survey values for insufficient stream buffers showed a significant lack of buffers in subunits 051401010201, 051401010203, 051401010204, 051401010205, and 051401010206. Although this was not specifically addressed as a stakeholder concern, it does tie to the stakeholder concern of using biological methods to control stream bank erosion.

Figure 61: Sub-Unit Visual Survey Values – Livestock in Woods



The visual survey values for livestock in woods indicated that subunit 051401010205 had more significant issues than the other 5 subunits. This is a stakeholder concern identified as fencing of livestock from sensitive areas which would include woodland.

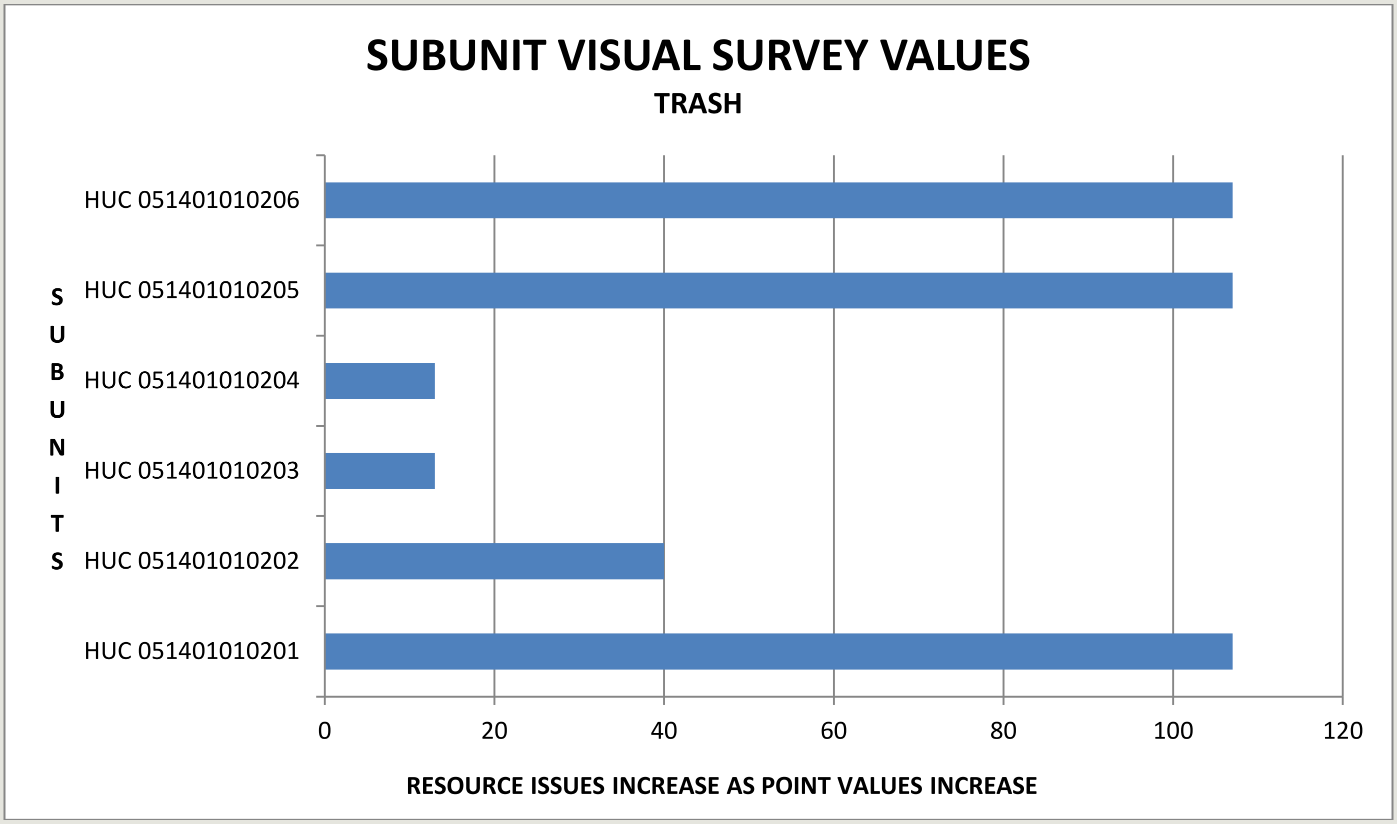
Figure 62: Sub-Unit Visual Survey Values – Septic Issues



The visual survey values on septic issues show potential concerns in subunits 051401010201 and 051401010202. These results may be skewed due to high values indicated during the 2010 and 2011 survey and no issues being reported during the 2013 survey. This is likely due to the subjective nature of individuals in identifying failing septic systems and variations in moisture conditions during the survey period which would cause differences in effluent being present on the soil surface.

However, pollution from failing septic systems and lack of septic systems in some cases were identified as local stakeholder concerns and may be justified due to the difficulty in identifying failing systems.

Figure 63: Sub-Unit Visual Survey Values – Trash



The visual survey values on trash in the watershed shows subunits 051401010201, 051401010202, 051401010205, and 051401010206 having issues with trash, such as abandoned auto bodies and scrapheaps containing tires, plastics, and metal.

Stakeholder concerns included dumping in the stream and dumping remains of wildlife by hunters. While conducting the survey there was little evidence of dumping in the stream and most sites found were on upland sites. Also, there was no evidence of dumping of wildlife remains**.**

Figure 64: Indian-Kentuck Watershed Water Quality Data Points

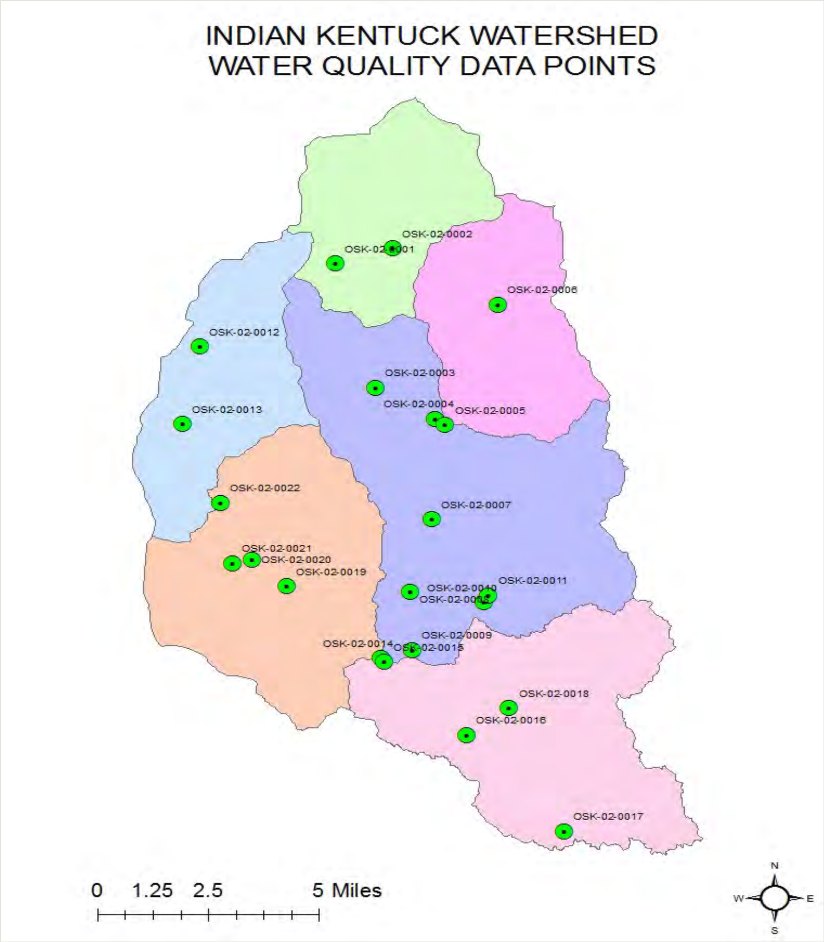


Figure 65: Water Testing Parameter,

Parameter	Target	Source
Dissolved Oxygen	>5mg/L but not < 4 mg/L and not > 12 mg/L (EPA recommendation)	327 IAC 2-1-6
pH	> 6 and < 9	327 IAC 2-1-6
Nitrate + Nitrite	< 1.5 mg/L	US EPA reference level (2000)
Total Phosphorus	< 0.076 mg/L	US EPA recommendation
Total Suspended Solids	< 25 mg/L	US EPA recommendation
Total Kjeldahl Nitrogen (TKN)	< 0.591 g/L	US EPA recommendation (2000)
Escherichia Coli	235 CFU/100 ml (single sample) or 125 CFU/100 ml (geo mean-5 equally spaced samples over a 30 day period)	327 IAC 2-1.5-8
Turbidity	< 10.4 NTU	US EPA recommendation (2000)
Macroinvertebrates index of biotic Integrity	>23 points	Hoosier RiverWatch (2011)

Target & Source Chart

Figure 66: Sub-Unit Water Quality Values – Dissolved Oxygen

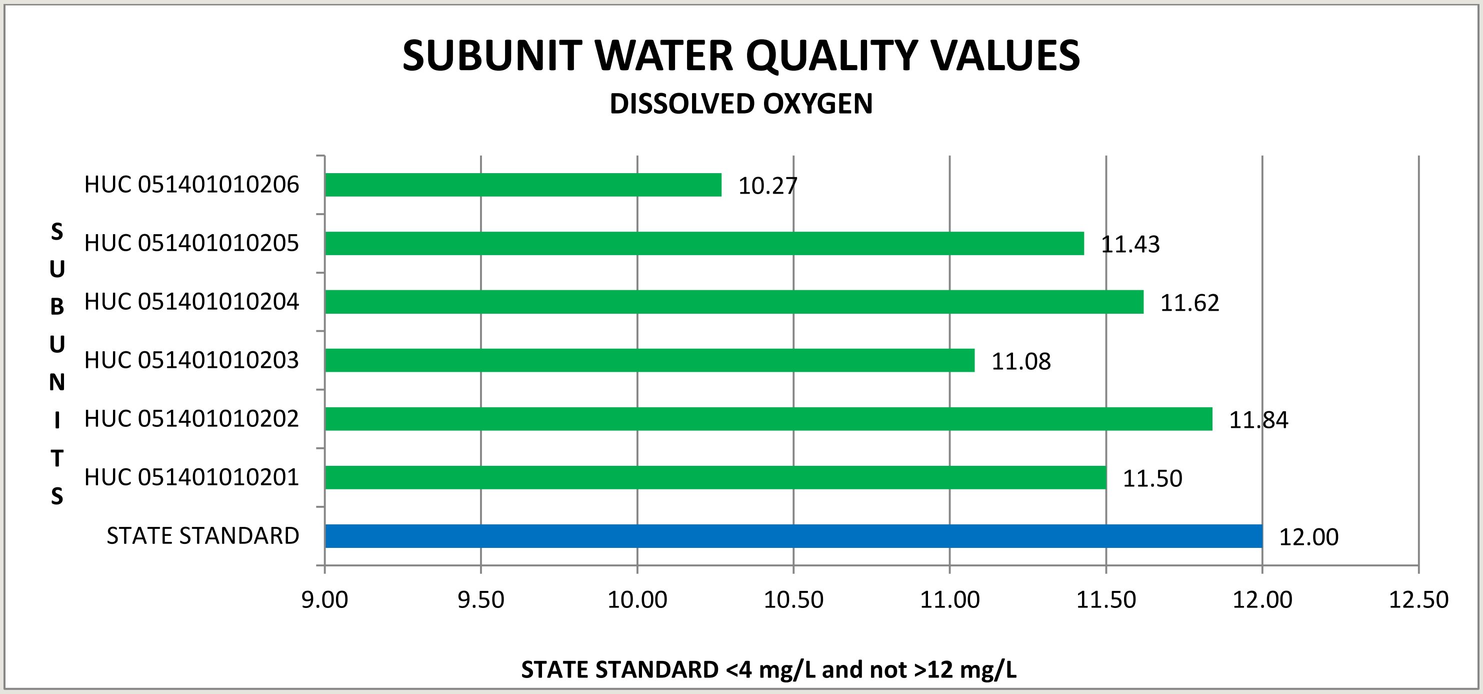


Figure 67: Dissolved Oxygen Tests that Exceeded State Standards

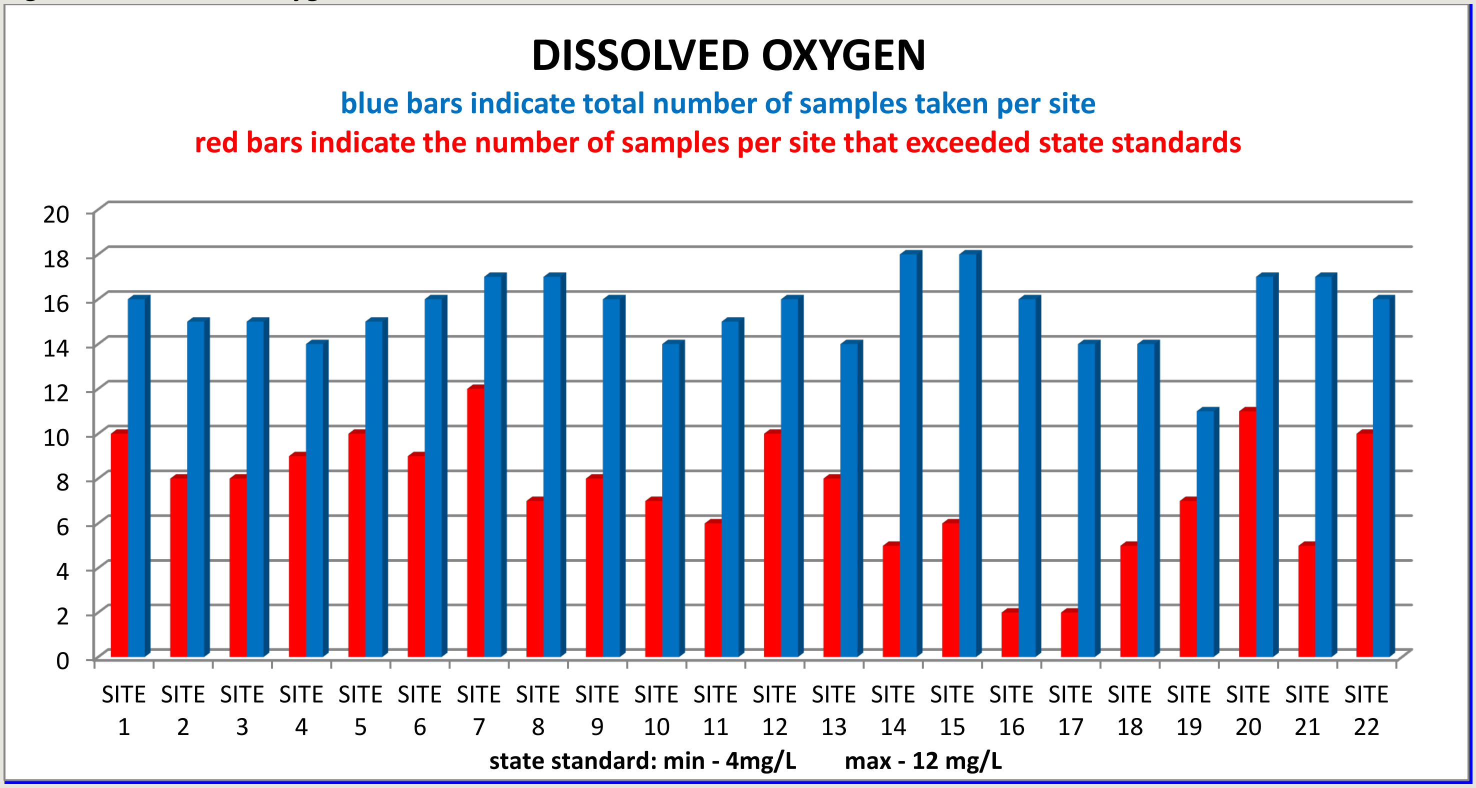


Figure 68: Sub-Unit Water Quality Values - pH

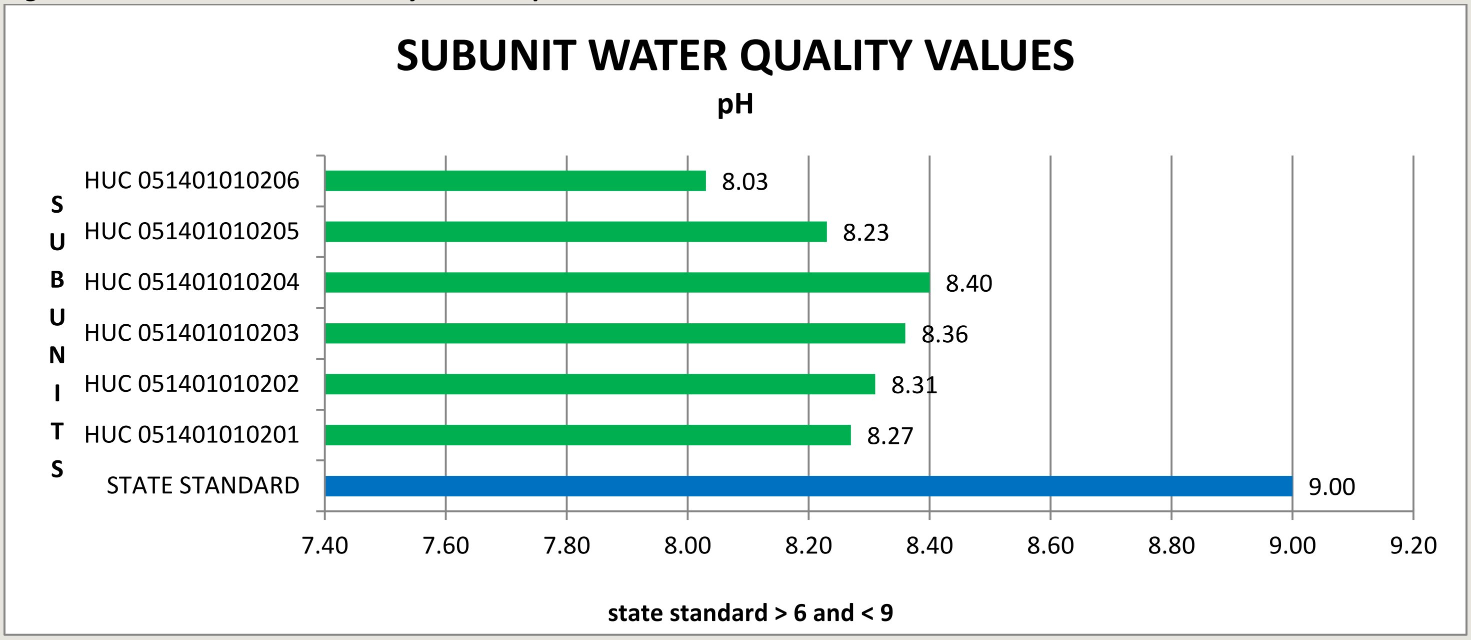


Figure 69: pH Tests that Exceeded State Standards

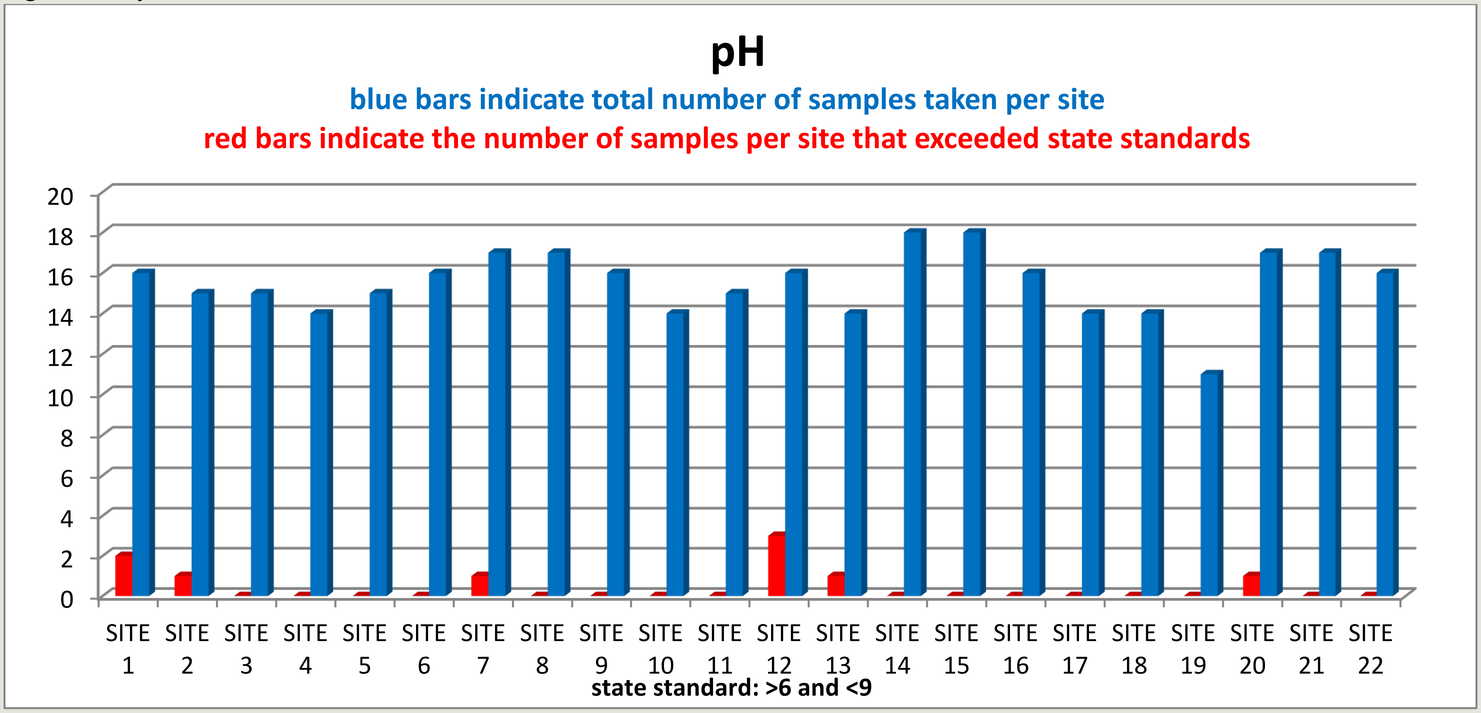


Figure 70: Sub-Unit Water Quality Values – Nitrate + Nitrite

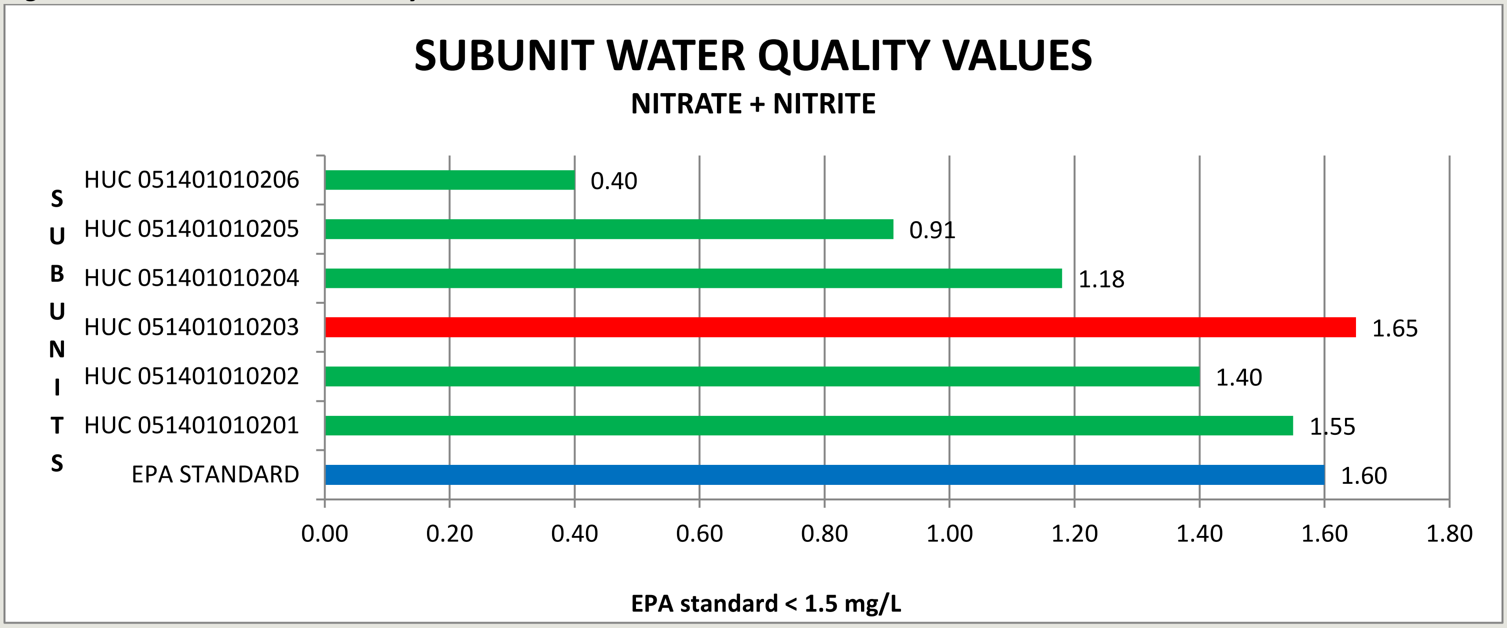


Figure 71: Nitrate + Nitrite Tests that Exceeded State Standards

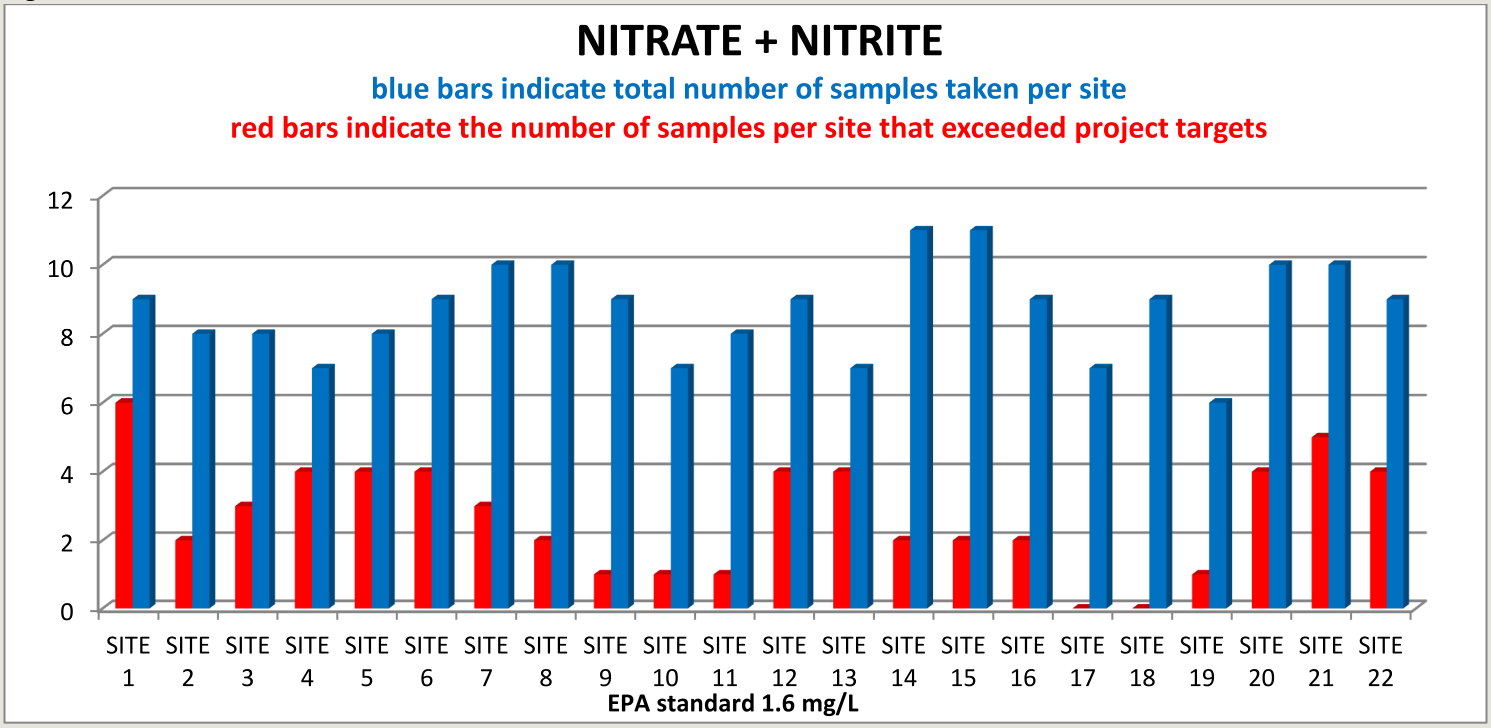


Figure 72: Sub-Unit Water Quality Values – Total Phosphorus

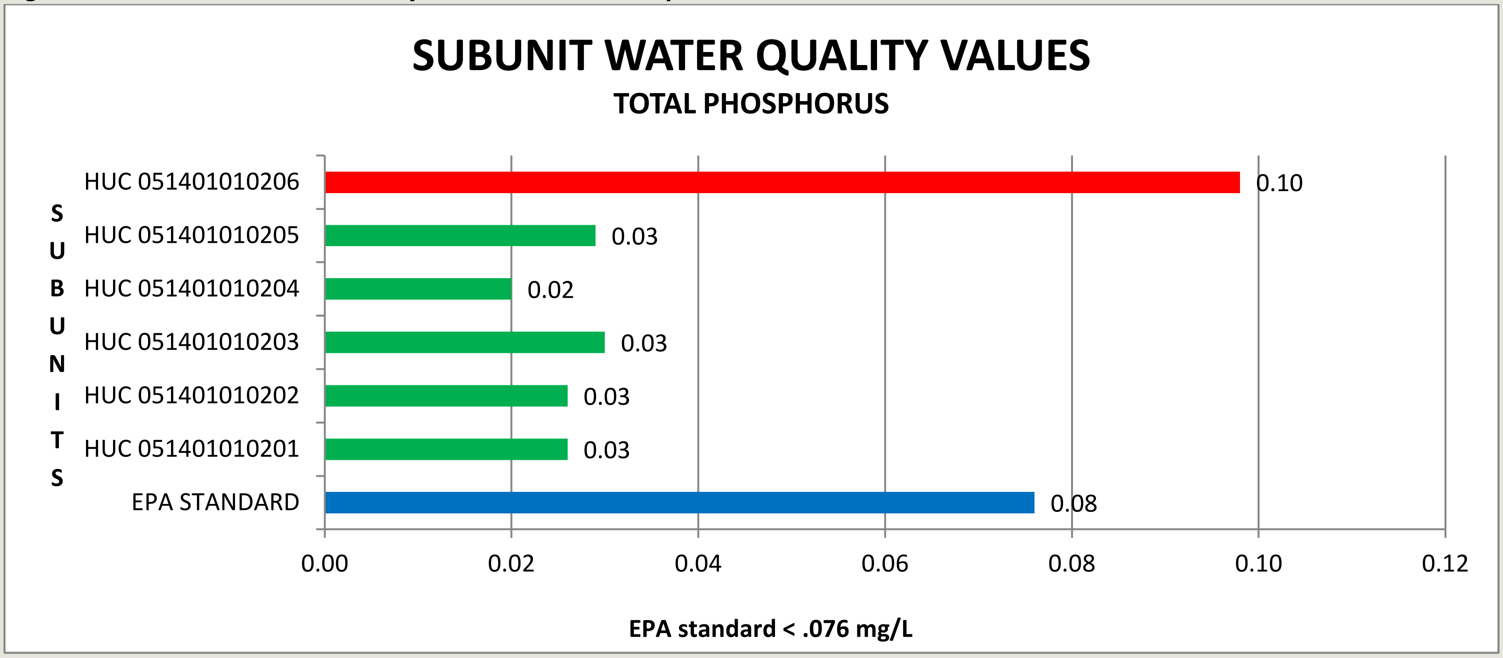


Figure 73: Total Phosphorus Tests that Exceeded State Standards

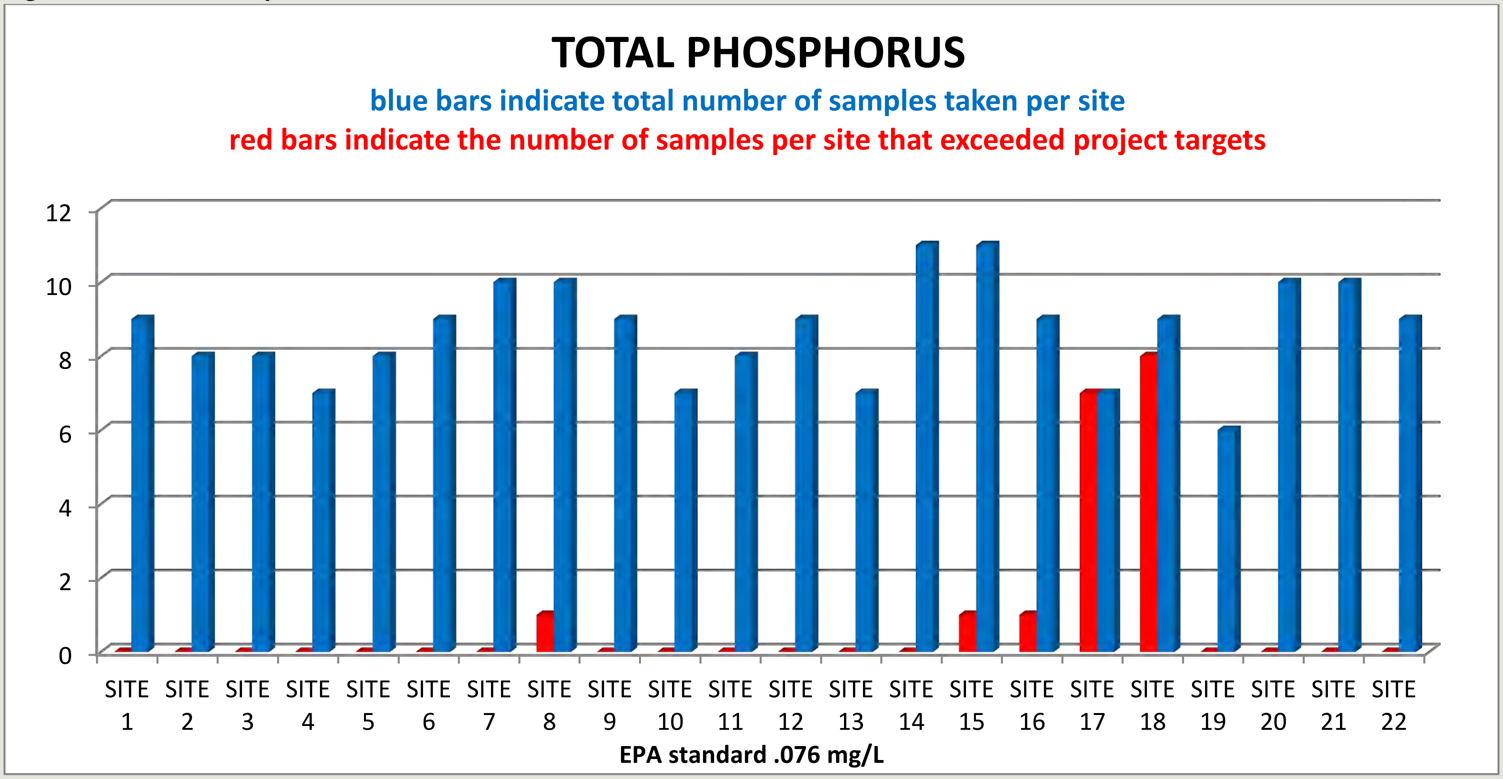


Figure 74: Sub-Unit Water Quality Values – Total Suspended Solids

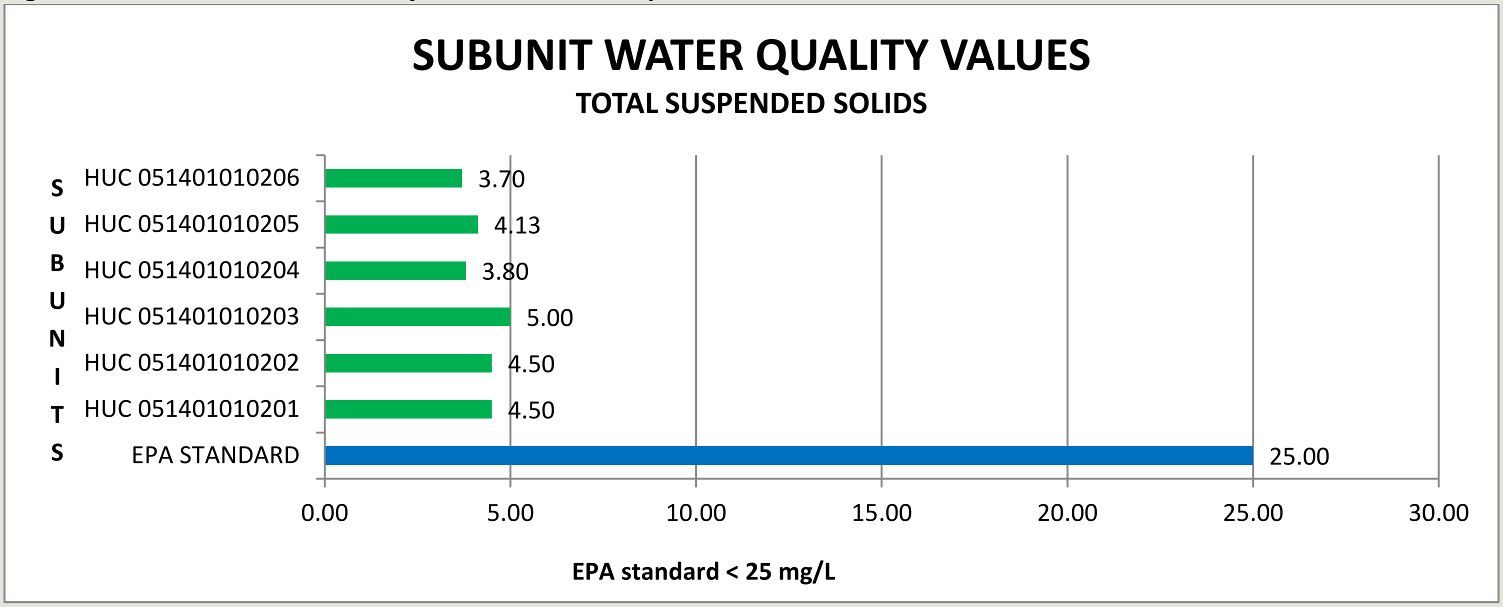


Figure 75: Total Suspended Solid Tests that Exceeded State Standards

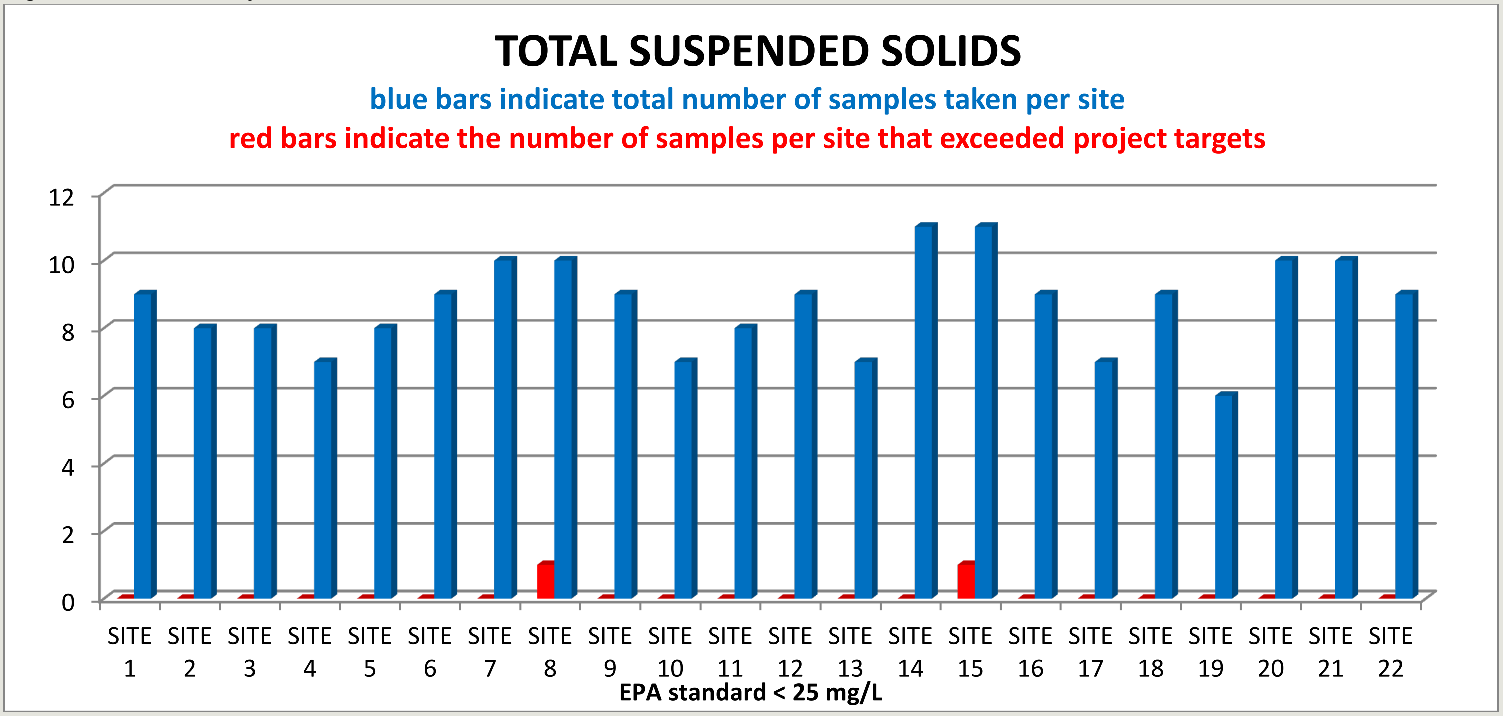


Figure 76: Sub-Unit Water Quality Vales – Total Kjeldahl Nitrogen

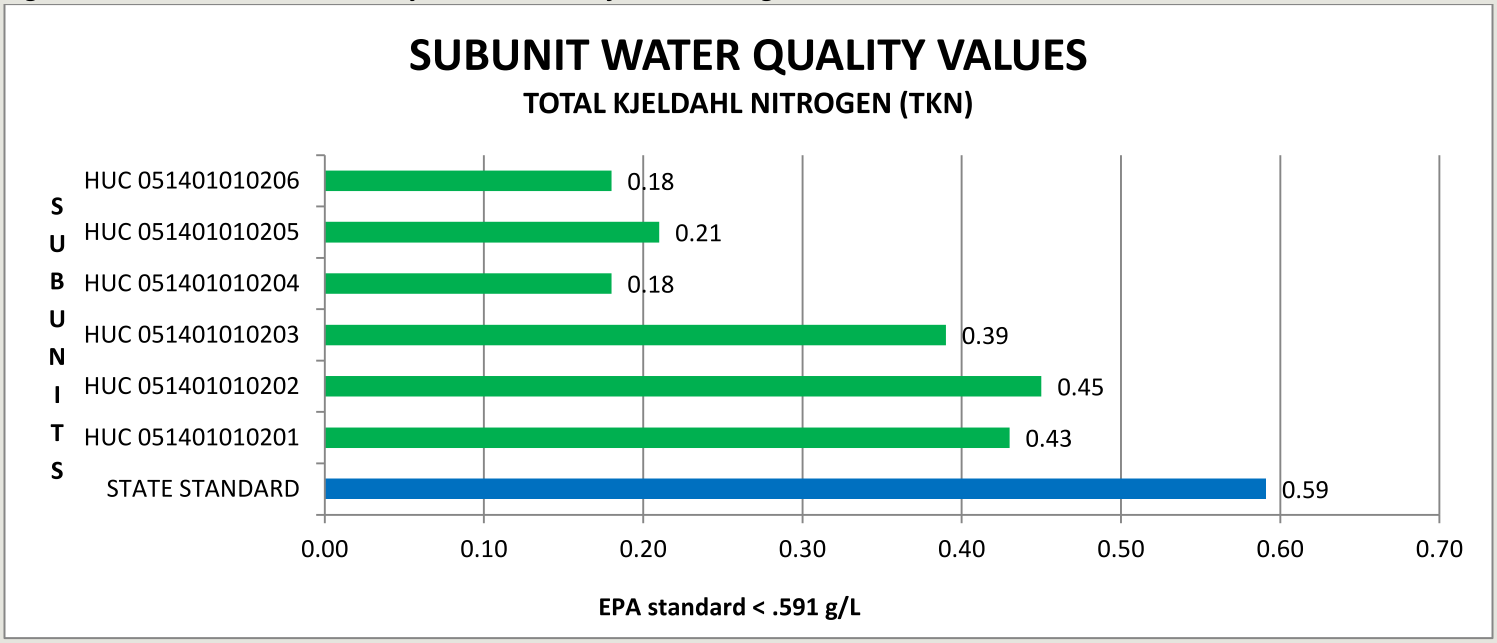


Figure 77: Total Kjeldahl Nitrogen Tests that Exceeded State Standards

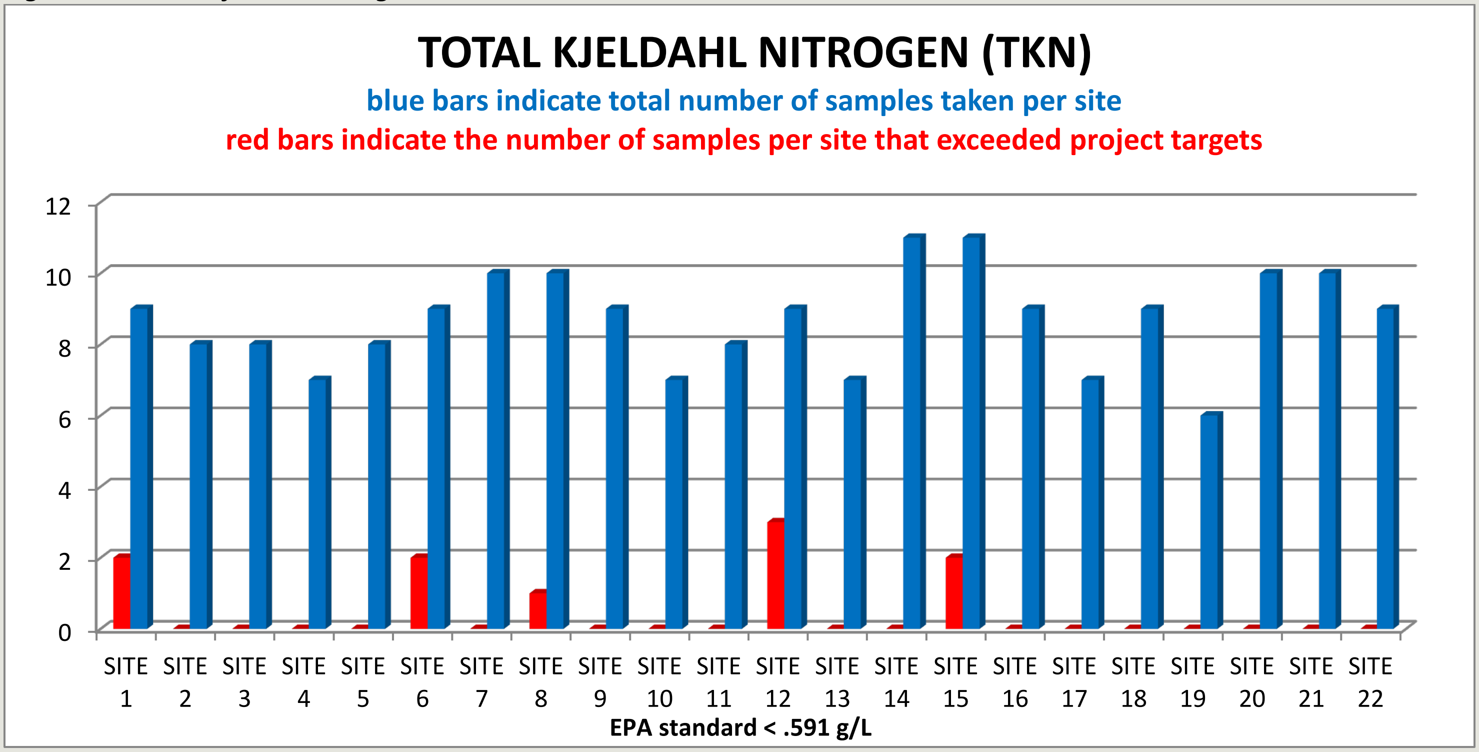


Figure 78: Sub-Unit Water Quality Values – E. coli Geomean

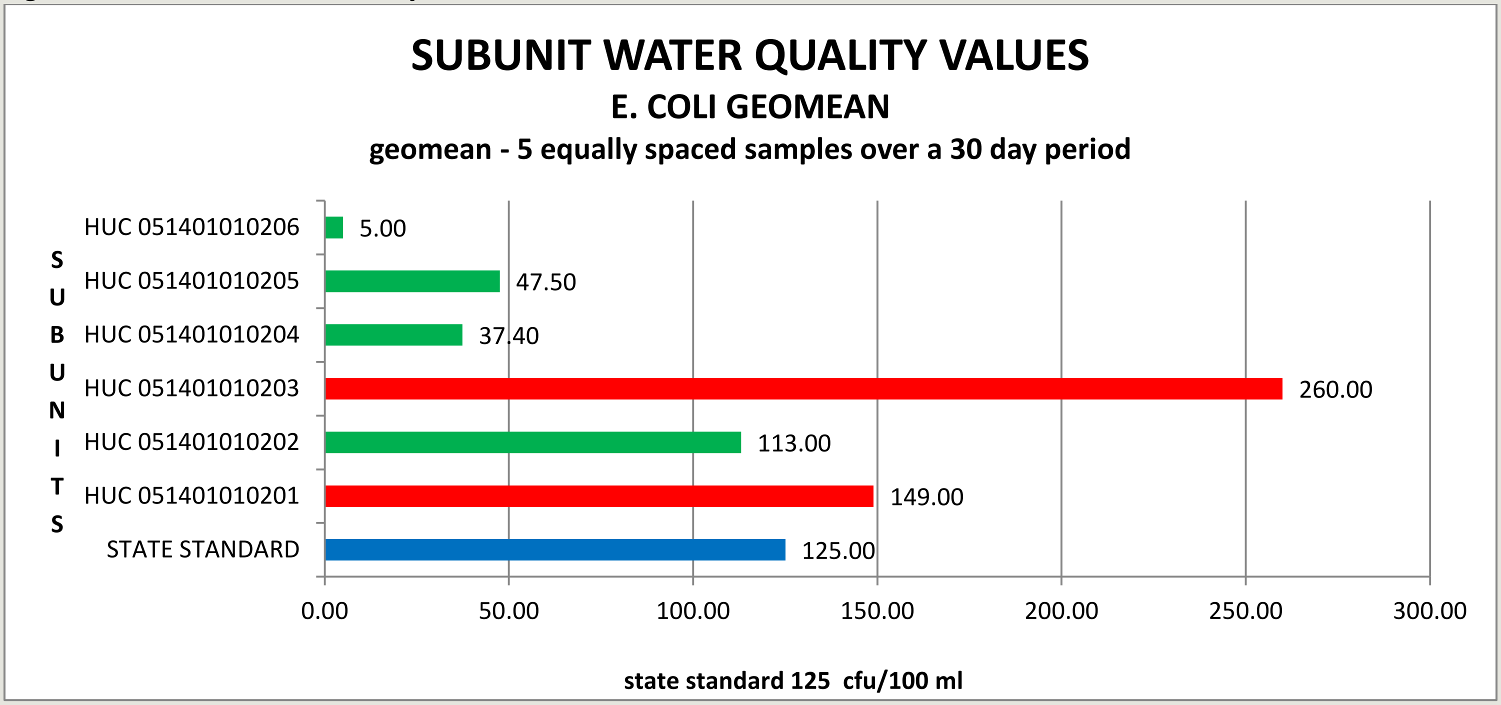


Figure 79: E. coli Tests that Exceeded State Standards

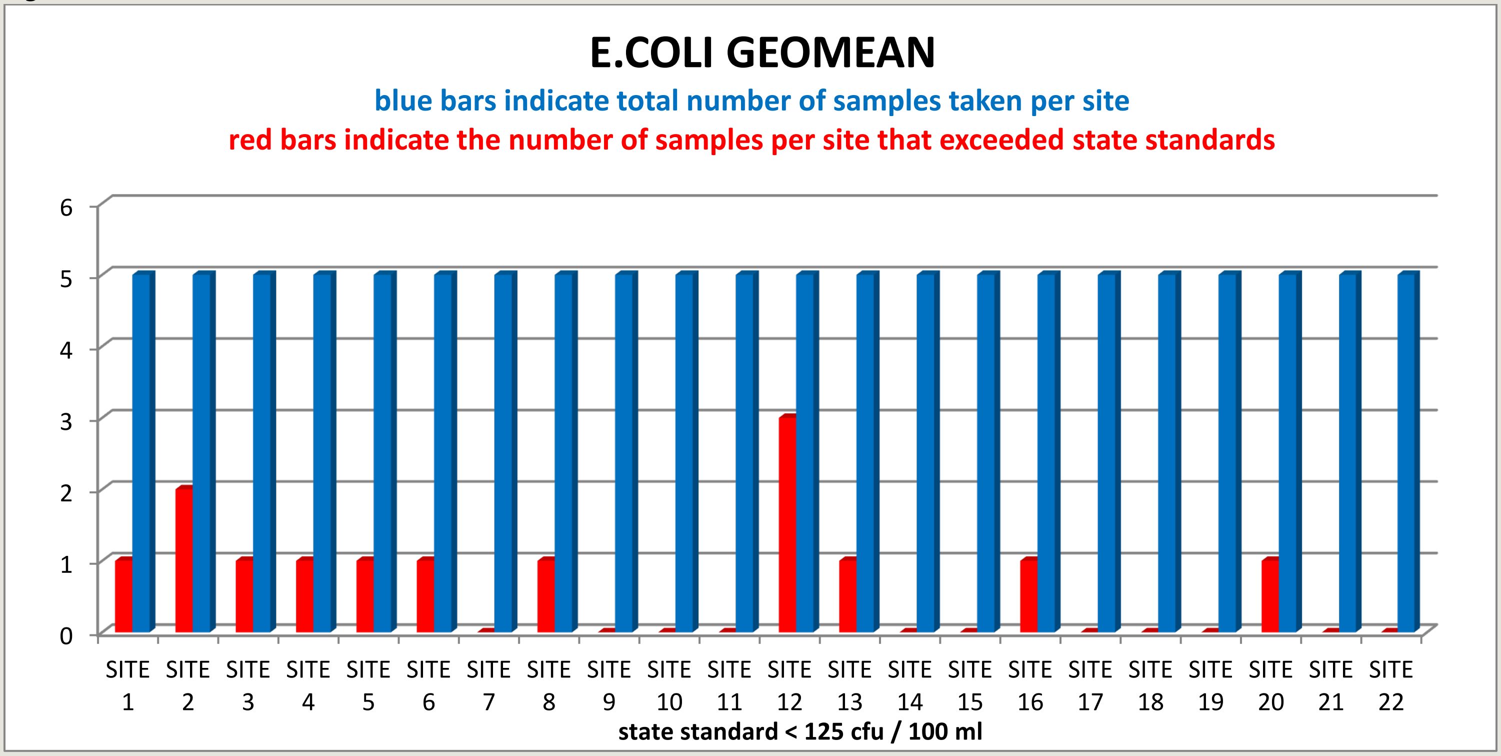


Figure 80: Sub-Unit Water Quality Values - Turbidity

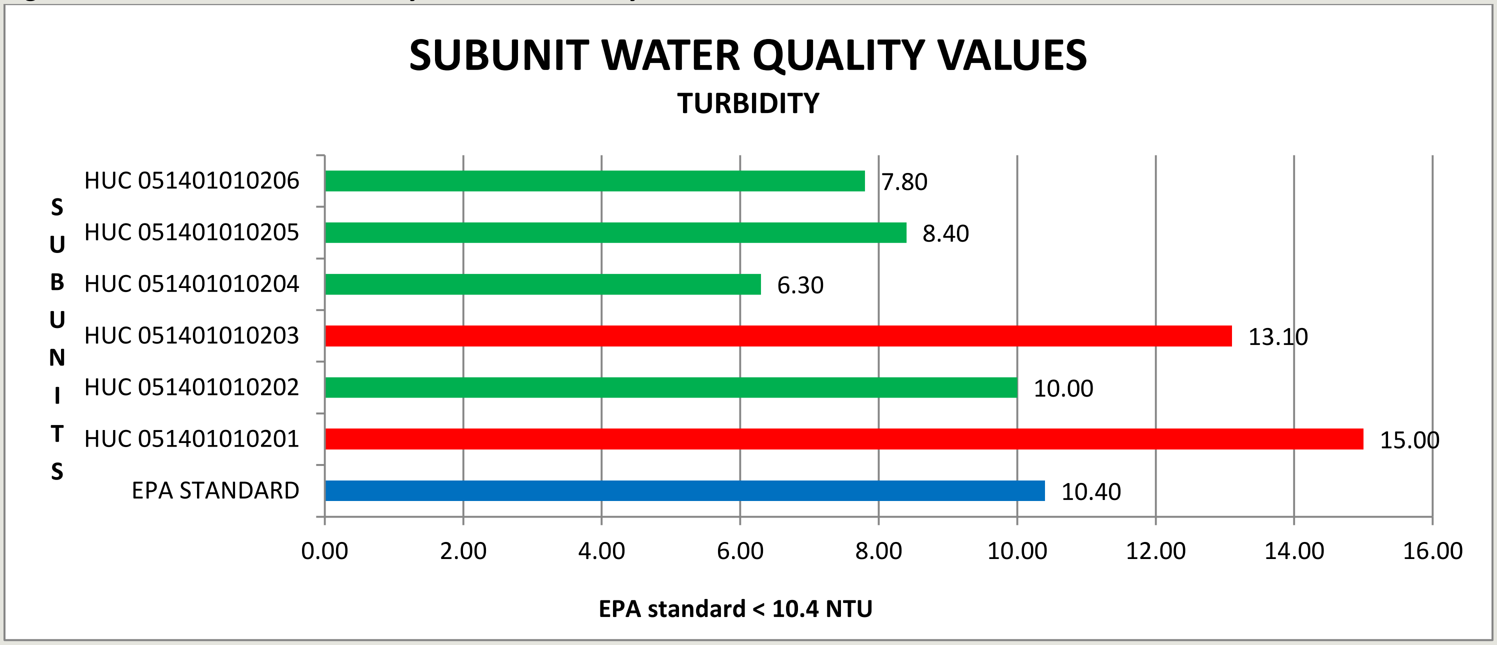
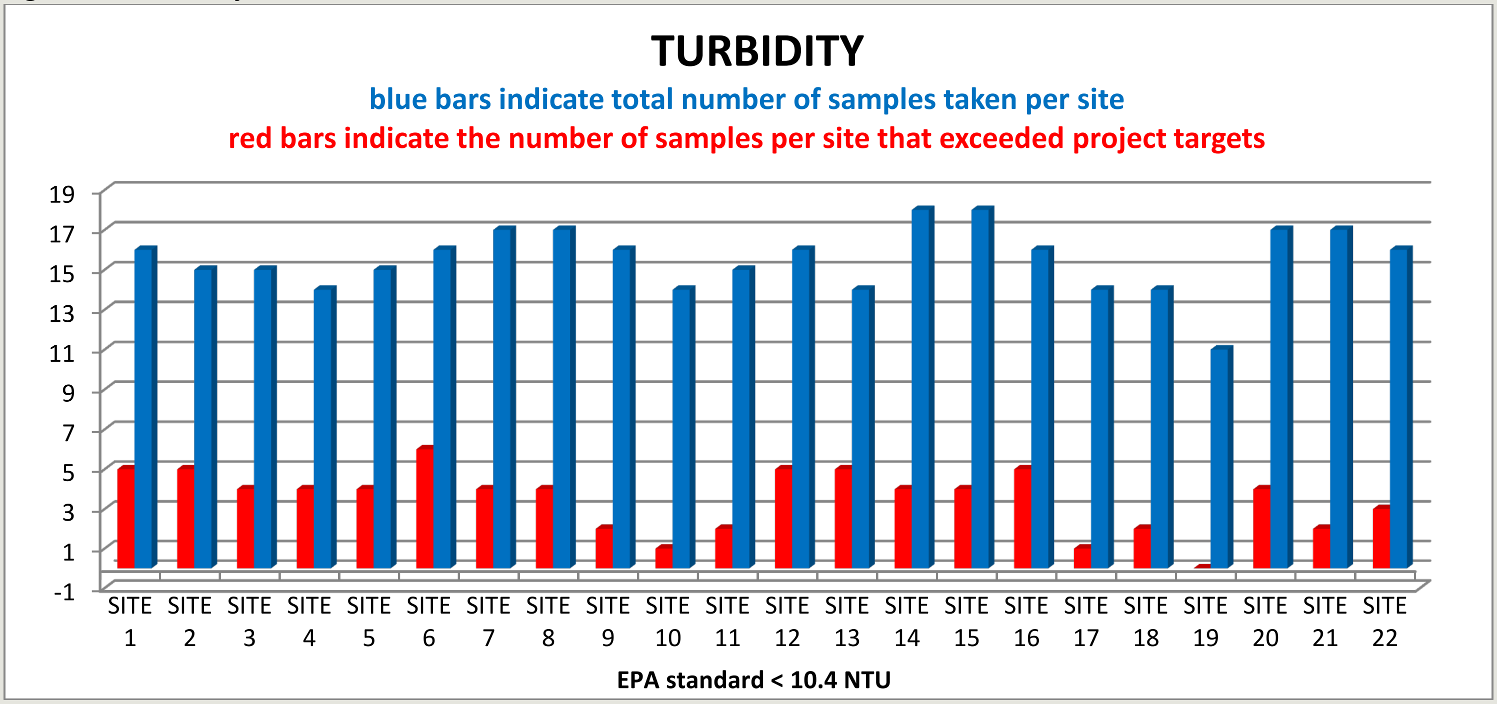


Figure 81: Turbidity Tests that Exceeded State Standards



WATER QUALITY SUMMARY

On average most water quality parameters fell within or slightly above state standards with the exception of high phosphorus levels in subunit 206 (Doe Run), high nitrate + nitrite in subunit 203 (headwaters west fork), high e. coli levels in subunits 201 (vestal branch) and 203 (headwaters west fork).

While the water quality averages fell close to state standards there were situations where every sample site on three parameters had levels that exceeded state standards on numerous occasions. This was the case involving dissolved oxygen, nitrate+nitrite, and turbidity. One half of the sites tested for e. coli exceeded state standards at least one time. This would indicate that there is a definite need to address these water quality issues in the future.

The water quality test results ties nicely with the visual survey results which showed insufficient crop residue, overgrazed pastures, livestock in water and woodland. All of these conditions relate to high levels of nutrients, e.coli, and turbidity in the stream.

Stakeholder concerns also seem to complement sampling results since most of the concerns centered on conditions that relate to soil erosion, livestock, and failing septic systems. All of these conditions can be connected to high nutrient levels, e.coli, and turbidity in the stream. It should be noted that the stakeholder concern of “invasive species in woodlands” was identified but not focused on due to no direct correlation with improving water quality within the watershed.

Figure 82: Analysis of Stakeholder Concerns

CONCERNS	SUPPORTED BY DATA	EVIDENCE	ABLE TO QUANTIFY	OUTSIDE SCOPE	GROUP WANTS TO FOCUS ON
Excessive gully erosion in cropland and pastures	Yes	The visual survey indicated insufficient residue amounts in the subunits 051401010201, 051401010202, 051401010203, 051401010204, and 051401010205. The subunits 051401010204, 051401010205, and 051401010206 showed overgrazed pastures at many sites. These factors can cause gully erosion in areas of concentrated flow. The IKW public survey indicated that 80.2% of the 82 responding felt that soil erosion was a problem.	Yes	No	Yes
Too much conventional tillage of cropland	Yes	The visual survey indicated insufficient residue amounts in the subunits 051401010201, 051401010202, 051401010203, 051401010204, and 051401010205. Water quality data indicates high turbidity, high nitrate+ nitrite, and high total kjeldahl nitrogen (TKN) levels in 051401010201, 051401010202, and 051401010203 subunits. These are indicators of concentrated runoff due to lack of residue. The IKW public survey indicated that 80.2% of the 82 responding felt that soil erosion was a problem. This is confirmed in the CTIC data presented in the landuse section of this report.	Yes	No	Yes
Lack of grade stabilization structures to control runoff from cropland	Yes	Though not identified in the visual survey many of the subunits with insufficient residue will often be lacking a grade stabilization structure to efficiently discharge runoff.	Yes	No	Yes
Stream bank erosion	No	Though not identified in the visual survey many of the subunits may have stream bank erosion occurring as indicated by high turbidity levels. This is especially true in the subunits 051401010201, 051401010202, and 051401010203 due to their levels being extremely high and exceeding EPA standards in the case of 0514010101 and 051401010203. During the public meeting to identify stakeholder concerns it was noted that they would like to see more biological methods used to control stream bank erosion. The IKW public survey indicated that 43.6% of the 73 responding felt that stream bank erosion was a problem.	Yes	No	Yes

CONCERNS	SUPPORTED BY DATA	EVIDENCE	ABLE TO QUANTIFY	OUTSIDE SCOPE	GROUP WANTS TO FOCUS ON
Need for soils education involving, compaction, cover crops and nitrogen fixation issues	Yes	The visual survey indicated insufficient residue amounts in the subunits 051401010201, 051401010202, 051401010203, 051401010204, and 051401010205. . Water quality data indicates high turbidity, high nitrate+ nitrite, and high total kjeldahl nitrogen (TKN) levels in 051401010201, 051401010202, and 051401010203 subunits. These are indicators that an extensive educational program involving soil health and cover crops would be beneficial.	Yes	No	Yes
Sinkholes in crop and pasture fields	Yes	Although not identified on the visual survey, there are numerous sinkholes within the watershed as noted with the map “Sinkholes located in the Indian-Kentuck Watershed” located in the Geologic section of this report. It is within the scope of this project to educate stakeholders of the direct link between sinkholes and water quality.	Yes	No	Yes
Sedimentation from erosion caused by overgrazing	Yes	The subunits 051401010204, 051401010205, and 051401010206 showed overgrazed pastures at many sites during the visual survey. In the IKW public survey 27.1% of the 87 responding were familiar but not using pasture or hayland management techniques to reduce runoff.	Yes	No	Yes
Livestock in the creek	Yes	The visual survey indicated that 051401010203, 051401010204, 051401010205, and 051401010206 had high incidents of livestock having access to the creek. In the IKW survey 36.4% of the 88 responding were not using critical area fencing to keep livestock from sensitive areas.	Yes	No	Yes
E.coli within the streams	Yes	The water quality testing data indicate that 051401010201 and 051401010203 have geo-mean E.coli levels above the state standard. In the IKW survey 36.4% of the 88 responding were not using critical area fencing to keep livestock from sensitive areas. The IKW public survey also indicated that 10.5% of the 86 responses had no septic system and there is no municipal waste system in the watershed.	Yes	No	Yes

CONCERNS	SUPPORTED BY DATA	EVIDENCE	ABLE TO QUANTIFY	OUTSIDE SCOPE	GROUP WANTS TO FOCUS ON
Pollution from failing septic systems and lack of septic systems in some cases	Yes	While there was no direct evidence of septic failure during the visual survey, there were high E.coli counts in the 051401010201 and 051401010203 subunits. There were also high Phosphorus levels in 051401010206 that exceeded EPA standards. Interestingly the IKW public survey indicated that 10.5% of the 86 responses had no septic system and there is no municipal waste system in the watershed.	Yes	No	Yes
Dumping in the stream	Yes	While conducting the visual survey there was little evidence of dumping in the stream and most dumping sites were found on upland sites. During filming of the management plan video several dumping sites in the stream were identified. The IKW public survey indicated that 55.8% of the 79 responding either didn't know or had a slight to not a problem response.	No	No	Yes
Permitting to do maintenance in the stream	No	While there is no evidence of a permitting process problem, there are stakeholders that are interested in assistance in filing permits.	No	Yes	No
Blockage of the stream due to rocks and trees	No	While there was no evidence of blockage of streams during the visual survey, it is quite likely that stakeholders have observed blockage throughout the watershed at different times.	No	No	No
Invasive species in woodland and cropland	Yes	While not recorded on the visual survey of the watershed, there were many woodland areas observed that had the invasive species ailanthus. There was no invasive noted in cropland.	No	No	No
Low quality plant species in pastures	Yes	There were many pastures with low quality species such as ironweed and bull thistle in the subunits 051401010203, 051401010204, 051401010205, 051401010206 noted in the visual survey.	Yes	No	Yes
Air quality application on chemicals	No	No supporting evidence through visual survey or any other data collected.	No	Yes	No

CONCERNS	SUPPORTED BY DATA	EVIDENCE	ABLE TO QUANTIFY	OUTSIDE SCOPE	GROUP WANTS TO FOCUS ON
Need for more timber stand improvement	No	No evidence observed	No	No	No
Need for more cover crops on cropland	Yes	During the visual survey the subunits of 051401010201, 051401010202, 051401010203, 051401010204, and 051401010205 had many crop fields with low residue and little or no evidence of cover crops. Turbidity levels exceeded EPA standards in 051401010201 and 051401010203. Nitrate + Nitrite also exceeded EPA standards in 051401010203. The IKW survey indicated that 29.8% of the 87 responding were not using cover crops for erosion protection and soil improvement.	Yes	No	Yes
Fencing of livestock from sensitive areas.	Yes	The visual survey indicated that there were insufficient stream buffers in the subunits of 051401010201, 051401010203, 051401010204, and 051401010205. There were many instances at these sites where there was a need to fence livestock from these areas. It was also noted that 051401010205 subunit had a high incidence of cattle in woodlands which makes it more susceptible to soil erosion. In the IKW survey 36.4% of the 88 responding were not using critical area fencing to keep livestock from sensitive areas.	Yes	No	Yes
Overpopulation of deer, harming of wildlife and dumping of wildlife remains.	No	These concerns were not observed in the visual survey but it is quite likely that a few stakeholders have experienced isolated situations where these conditions exist.	No	Yes	No
Sediment filling pools for fish, No Wake zone not being enforced, ATV's in the creek	No	These concerns were not observed in the visual survey but it is quite likely that a few stakeholders have experienced isolated situations were these concerns were noted.	No	Yes	No

IDENTIFYING PROBLEMS AND CAUSES

In this section concerns identified by stakeholders in the watershed and through the watershed inventory will be linked to problems found through the watershed investigation. Additionally, potential causes for the problems identified will be expressed. Finally, potential sources will be identified. Figure 83 shows the connection between those concerns the stakeholders have chosen to focus efforts on, problems found in the watershed, and the potential causes and sources of those problems.

Figure 83: Stakeholder Concerns, Problem, Potential Causes & Sources

Concern(s)	Problem	Potential Causes	Potential Source
Excessive gully erosion	Causing turbidity levels that exceed accepted standards.	BMP's underutilized Fear of change Expense to change	Visual survey indicates Insufficient residue amounts in 18 of the 41 cropland sites. Occurring primarily in the subunits of 201, 202, 203, 204, and 205. The subunits of 204, 205, and 206 also showed overgrazed pastures at many sites. Subunits 201,202,203 have turbidity levels that just meet and in 2 subunits exceed water quality standards.
Too much conventional tillage of cropland	Causes high turbidity, high nitrate+nitrite, and high total kjeldahl nitrogen (TKN) levels	BMP's underutilized Fear of change Expense of change Spec. crop (tillage req.)	The 2013 visual survey indicates Insufficient residue amounts in 18 of the 41 cropland sites. 59.6% of the watershed has HEL soil units and 20.5% as PHEL soils. High turbidity, high nitrate+nitrite, and high total kjeldahl nitrogen (TKN) levels were indicated in 201, 202, and 203 subunits.
Lack of grade stabilization structures	Lack of structural outlets on many crop fields which contributes to the formation of gullies and high turbidity and nutrient levels.	BMP's underutilized Not feasible for small operator.	Subunits 201,202,203 have the highest acreage of cultivated crops comprising 10.8% of the total acreage in the IK Watershed. Cultivated cropland typically has grassed waterways in need of stabilization structures. Subunits 201,202,203 have turbidity levels that just meet and in 2 subunits exceed water quality standards. This would indicate potential erosion problems.
Stream bank erosion	Stream bank erosion causes high turbidity levels and causes loss of productive crop fields.	Faster runoff – steep topography. More severe storm events and stream blockage.	There was no visual survey completed to identify stream bank erosion sites but discussions with stakeholders indicate there are several areas where stream bank erosion is a problem. Water quality sample values in subunits 201,202,203,205,206 indicated high turbidity levels which could be an indicator of stream bank erosion.

Concern(s)	Problem	Potential Causes	Potential Source
Need for soils education involving, compaction, cover crops and nitrogen fixation issues	Without proper educational opportunities land users may not realize or take advantage of the latest technological advances which may have benefits to the individual and their environment.	Expense to implement educational program Expense to meet and follow up with producers	N/A
Sinkholes in crop and pasture fields	Provides a direct route for pollutants to enter ground water and can add to nutrient contamination of ground water.	Due to the high cost of productive cropland, landowners are reluctant to put areas in buffers.	IKW has 59.6% of the soils classified as HEL and 20.5% as PHEL.
Sedimentation from erosion caused by overgrazing	Overgrazing causes sparse groundcover which allows sheet and rill erosion on pasture land. Causes high turbidity, high nitrate+nitrite, and high total kjeldahl nitrogen (TKN) levels	Lack of rotational grazing due to cost of installation and maintenance of fence	The 2013 visual survey indicated 17 sites with overgrazed pastures. IKW has 59.6% of the soils classified as HEL and 20.5% as PHEL. Subunits 201,202,203 have turbidity levels that just meet and in 2 subunits exceed water quality standards. This would indicate potential erosion problems.
Livestock in the creek	Causing high turbidity, E.coli, and possible phosphorus levels	Lack of alternative watering systems due to lack of technical help and the expense	The 2013 visual survey indicated 17 sites with livestock in the water primarily in subunits 203,204,205,206. E.Coli geomean data indicated subunits 201,202,203 near or exceeding water quality standards.
E.coli within the streams	Making the stream unsafe for many uses, such as recreational activities.	Livestock and wildlife in the streams Failing and in some cases no septic systems	99.7% of soils in watershed are poorly suited for septic systems. The 2013 visual survey indicated 17 sites with livestock in the water primarily in subunits 203,204,205,206. E.Coli geomean data indicated subunits 201,202,203 near or exceeding water quality standards.

Concern(s)	Problem	Potential Causes	Potential Source
Low quality plant species in pastures	Leads to overgrazing due to low productivity which will cause erosion to occur.	BMP's underutilized	The 2013 visual survey indicated 17 sites with overgrazed pastures.
Need for more cover crops on cropland	Without cover crop fields are vulnerable to soil erosion, in the IKW this is especially true for specialty crops such as tobacco. Causes high turbidity, high nitrate+nitrite, and high total kjeldahl nitrogen (TKN) levels	BMP's underutilized Expense Fear of change	The 2013 visual survey indicates Insufficient residue amounts in 18 of the 41 cropland sites. This occurred in the subunits of 201, 202, 203,204, and 205. High turbidity, high nitrate+nitrite, and high total kjeldahl nitrogen (TKN) levels were indicated in 201, 202, and 203 subunits. IKW has 59.6% of the soils classified as HEL and 20.5% as PHEL.
Fencing of livestock from sensitive areas	May lead to high E.coli levels in streams and erosion in wooded areas.	Accessibility to area to be fenced Expense	The 2013 visual survey indicated 17 sites with livestock in the water primarily in subunits 203,204,205,206. There were 11 sites with livestock in woodland areas.
Pollution from septic systems	Many of the septic systems are antiquated and in some cases may be nonexistent, potentially leading to high nutrient levels and e. coli.	Soils suitability is poor for conventional septic system fields Lack of understanding and expense	99.7% of soils in watershed are poorly suited for conventional septic systems. E.Coli geomean data indicated subunits 201,202,203 near or exceeding water quality standards.
Dumping	Chemical dumping could cause contamination of streams. Making many uses of recreational activities unsafe. Dumping of solid waste can make recreational sites unsuitable to use.	Lack of knowledge on proper disposal systems.	The 2013 visual survey indicated 6 sites where trash was present. This trash was primarily solid waste such as appliances, vehicles, tires, and discarded household containers.

CURRENT LOADS FOR EACH POLLUTANT IDENTIFIED

Projects developing watershed management plans and wanting to secure Section 319 funds to implement a cost-share program are required to include estimates for existing pollutant loads within the watershed, as well as estimated pollutant load reduction that may result from the implementation of best management practices outlined in the watershed plan.

Load reductions where calculated using the Web-Based Load Duration Curve Tool (WBLDC) (https://engineering.purdue.edu/~ldc). The load duration curve establishes the relationship between stream flow and pollutant loading capacity, allowing the characterization of water quality concentrations (or water quality data) at different flow regimes. This tool also provides a useful interpretation of the stream flow patterns/flow conditions that influence water quality impairments, thus allowing the user to estimate the frequency and magnitude of water quality standard exceedances and load reductions necessary to achieve water quality goals for watersheds. Sampling data from IDEM and the USGS stream gage in Canaan were used in the load reduction calculations.

Current pollution loads and load reductions were analyzed for nitrogen, total phosphorus, and sediment only, as *E.coli* loads cannot be accurately determined. Even though load reductions cannot be determined for *E. coli* it is important to understand that it poses significant risk to the health of the watershed.

In order to put the current load estimates in the context of water quality, target loads were calculated using state water quality standards or recommended guidelines agree to by the Indian-Kentuck Steering Committee. The figures below show the amount of annual pollutant loads that the stream can assimilate and still meet the state standards or recommended guidelines. The charts also show the reduction needed if pollutant loads are above the standards set by the steering committee.

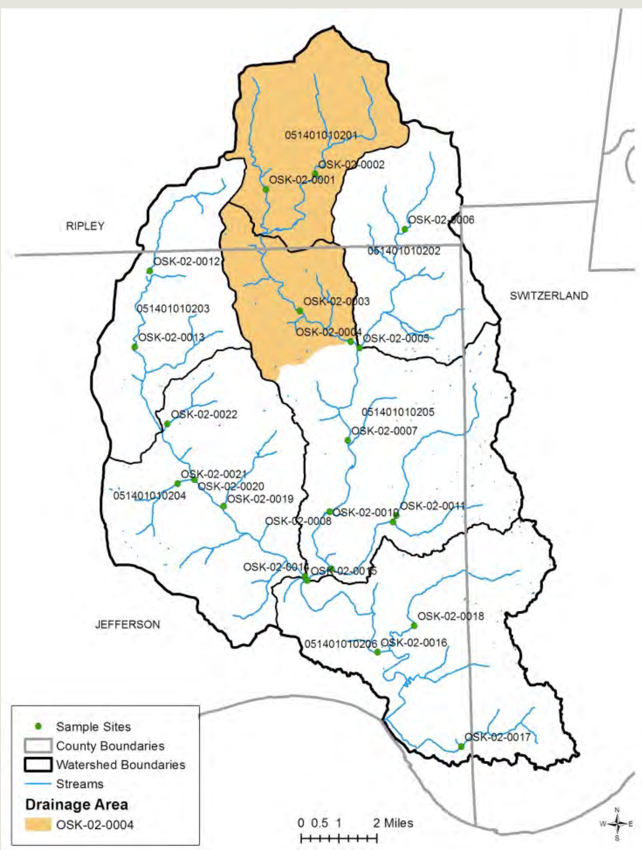


Figure 84: Pollutant Reductions: Vestal Branch Sub-Unit

VESTAL BRANCH SUBUNIT

Site 4 (17,600 ac)	90th Percentile Load (lbs. /yr.)	Target Load (lbs. /yr.)	Reduction Needed (lbs. /yr.)	Reduction Needed (%)
Nitrate-Nitrite	305,344	91,068	214,277	70.18
TKN	37,562	35,880	1,683	4.48
TP	3,365	4,614	-	
TSS	654,394	1,517,794	-	

Figure 85: Flow Duration - Nitrate

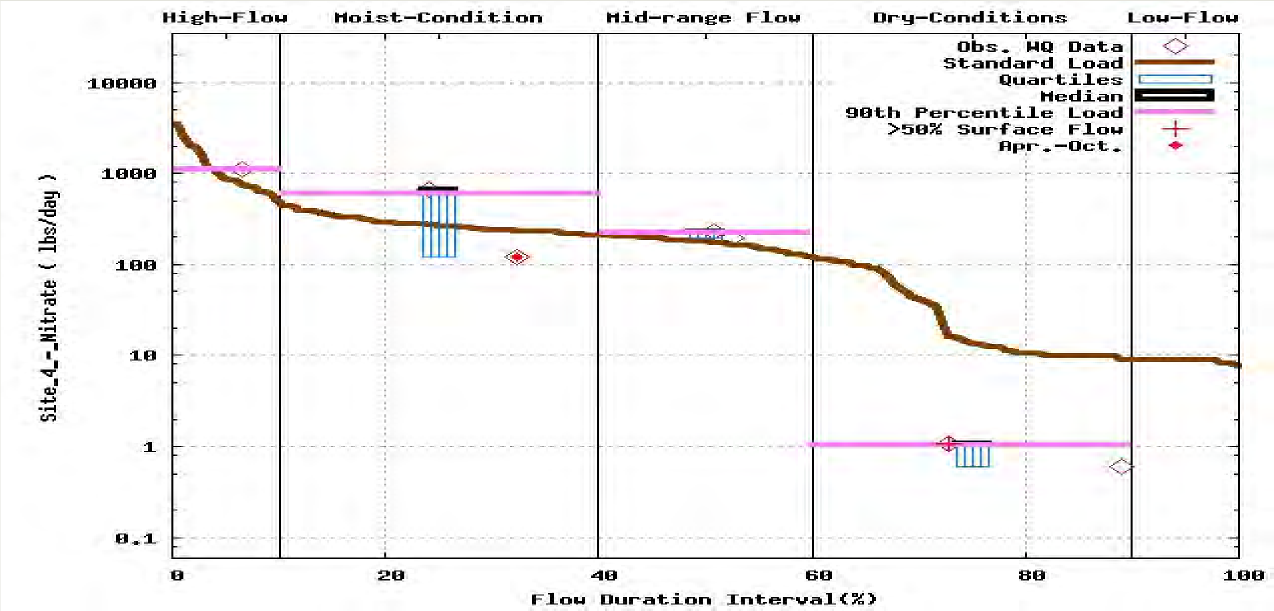


Figure 86: Flow Duration – TKN

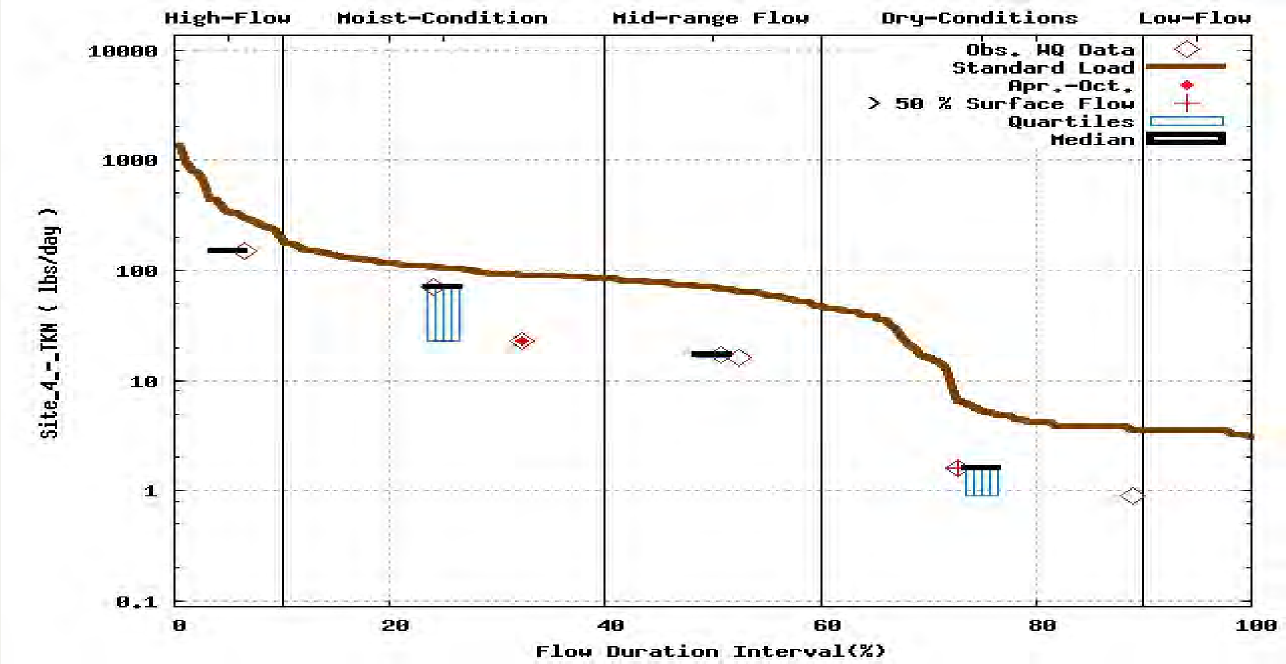


Figure 87: Flow Duration - TSS

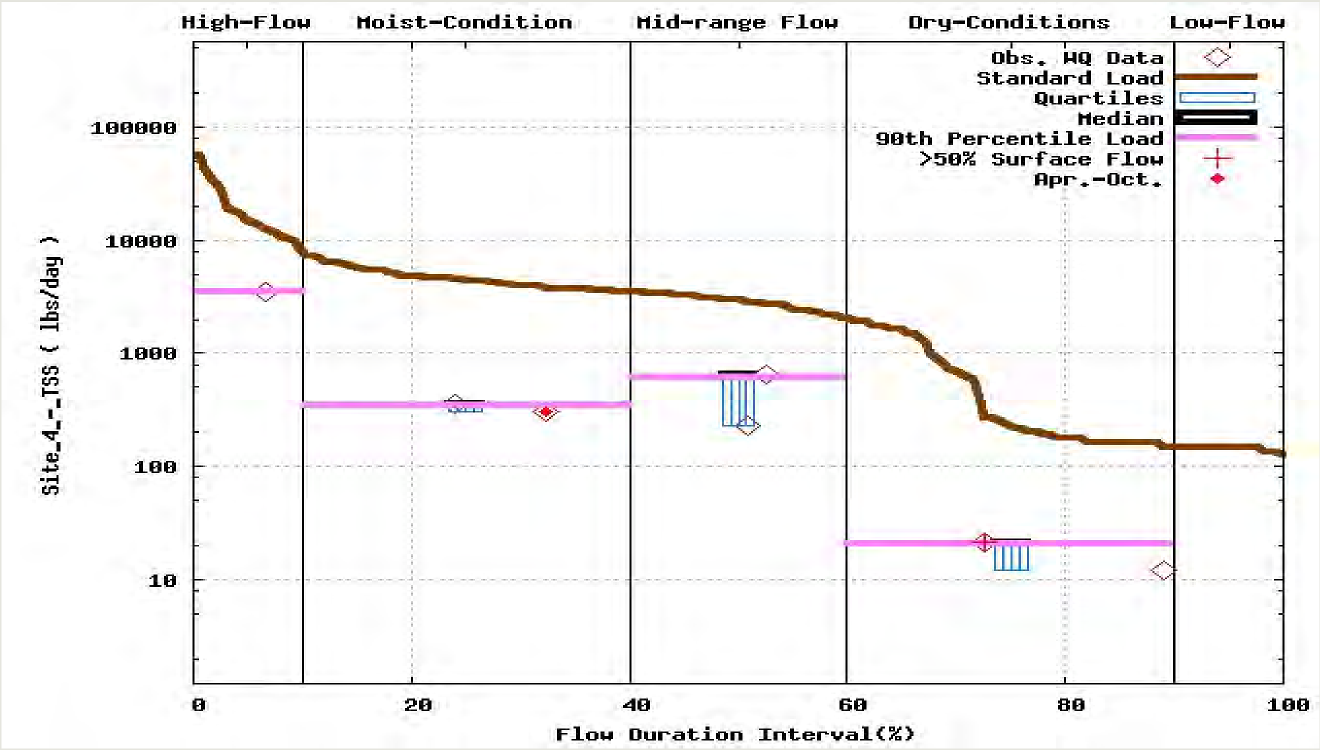


Figure 88: Flow Duration - TP

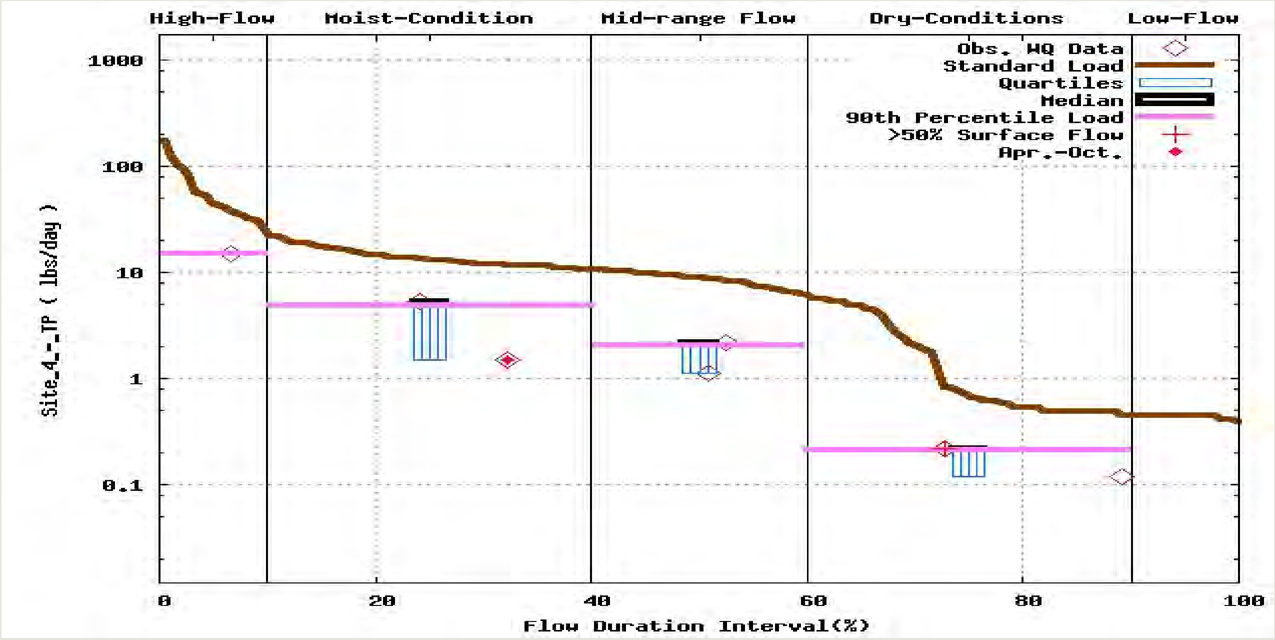
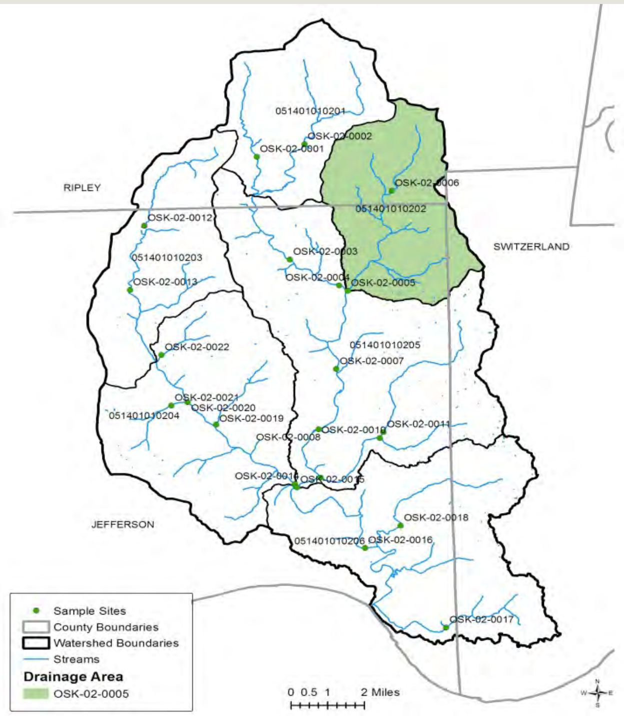


Figure 89: Pollutant Reductions: Wilson Fork Subunit



WILSON FORK SUBUNIT

Site 5 – USGS gage drainage area ratio (0.67)

Reductions needed: N

Site 5 (11,750 acres)	90th Percentile Load (lbs. /yr.)	Target Load (lbs. /yr.)	Reduction Needed (lbs. /yr.)	Reduction Needed (%)
Nitrate-Nitrite	172,254	35,515	136,740	79.38
TKN	17,706	13,994	3,712	20.96
TP	1,650	1,799	-	
TSS	208,145	591,917	-	

Figure 90: **Flow Duration - Nitrate**

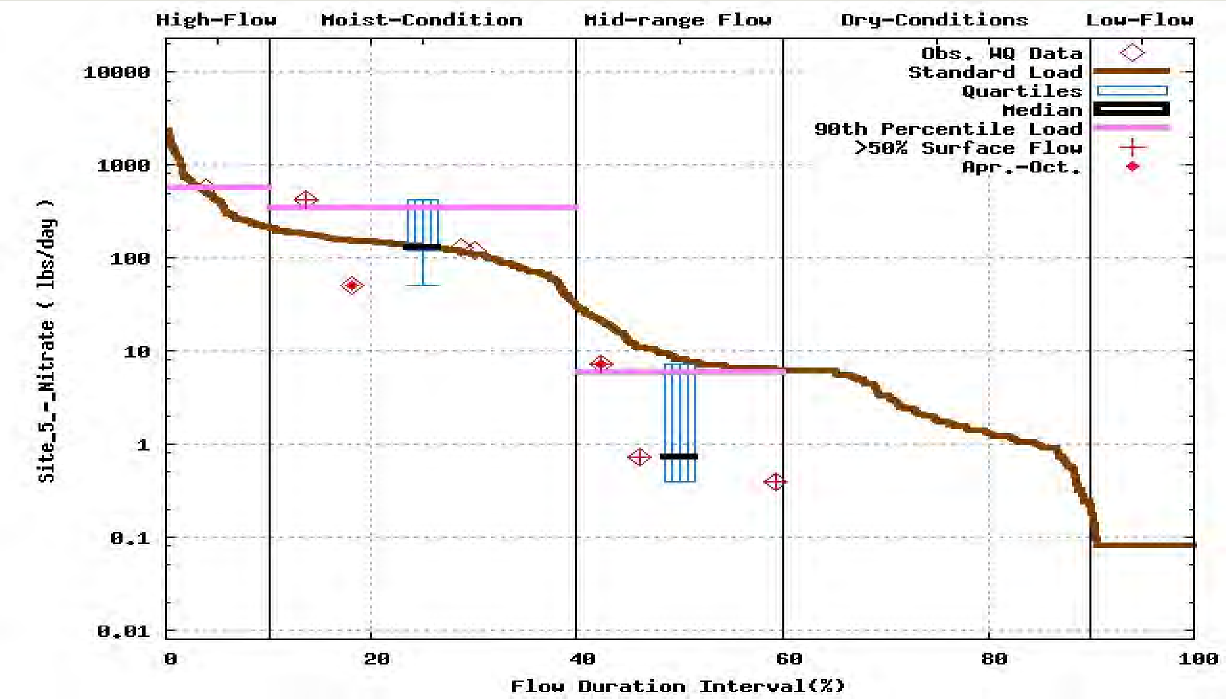


Figure 91: Flow Duration - TKN

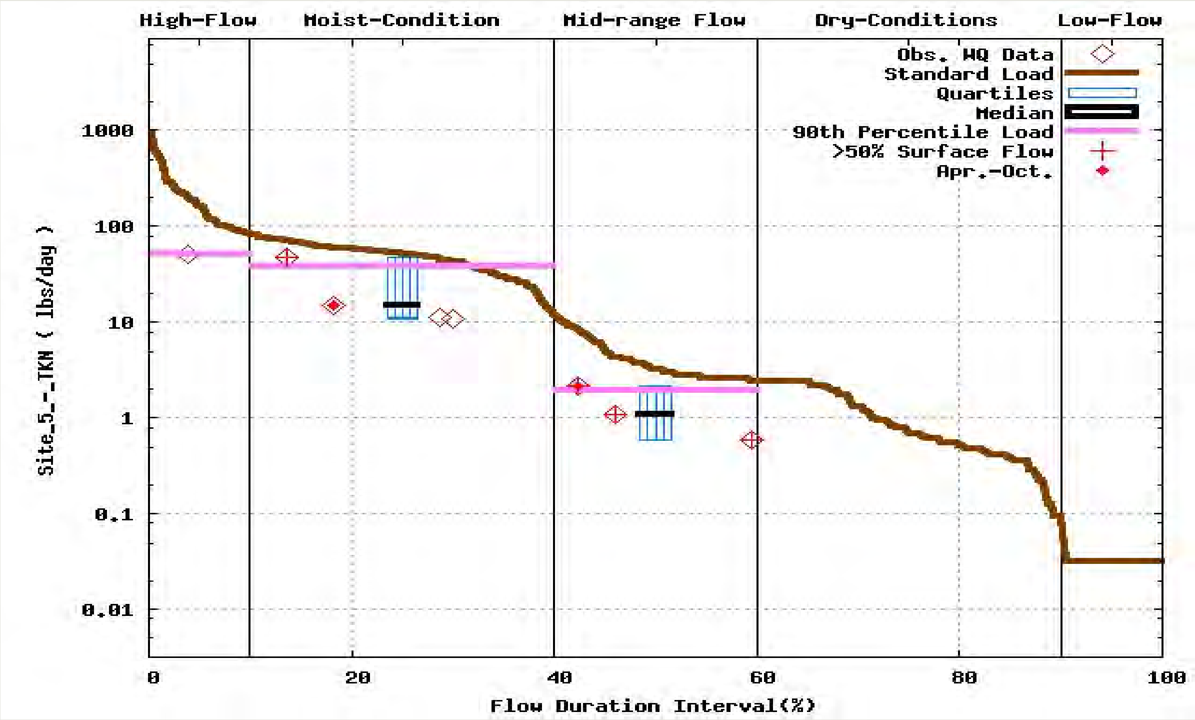


Figure 92: Flow Duration - TP

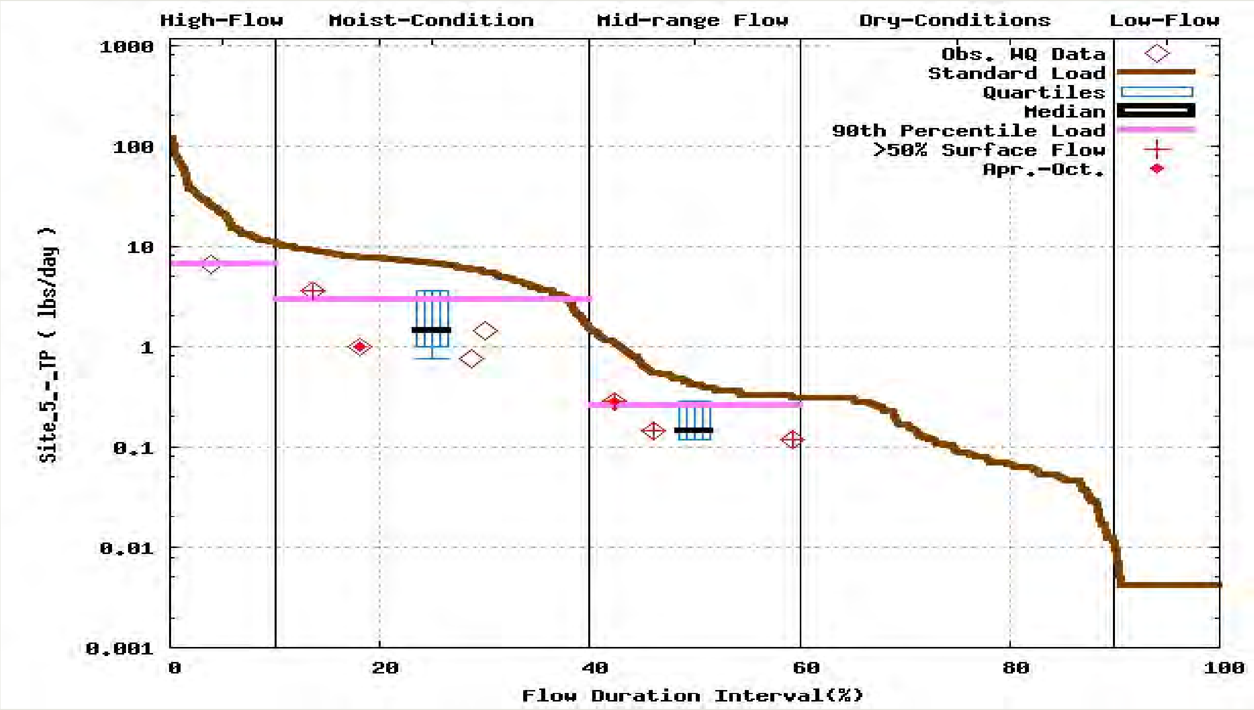


Figure 93: Flow Duration - TSS

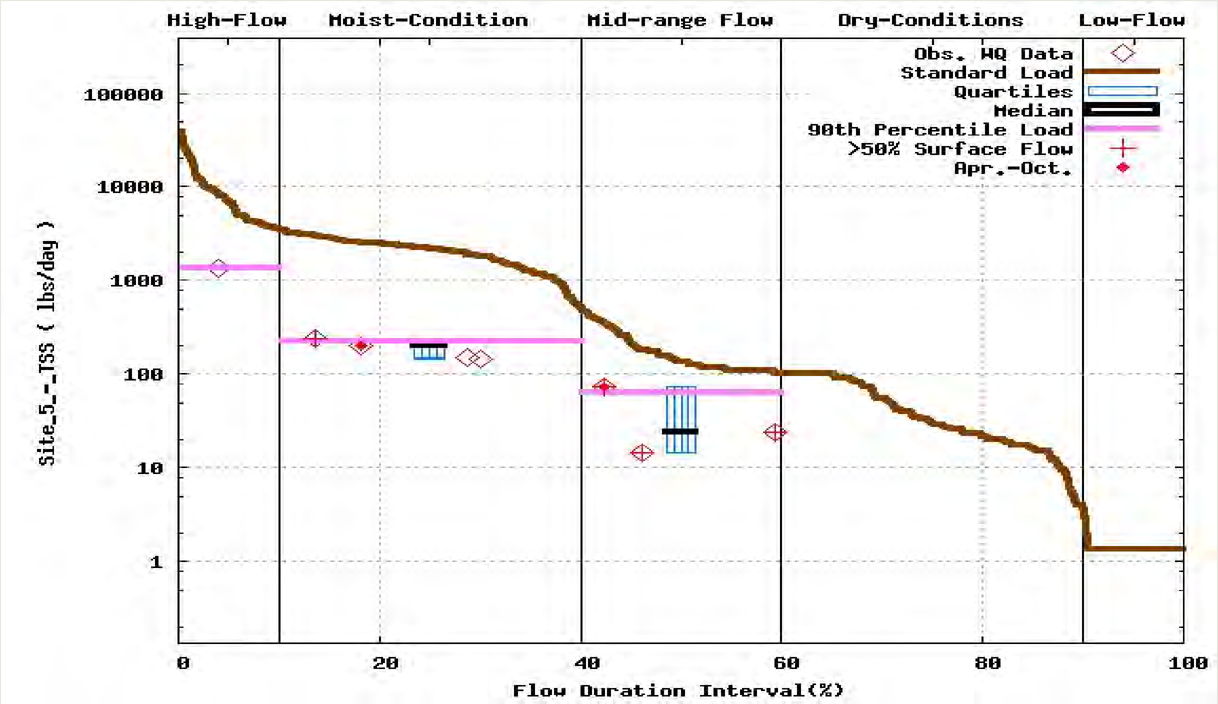
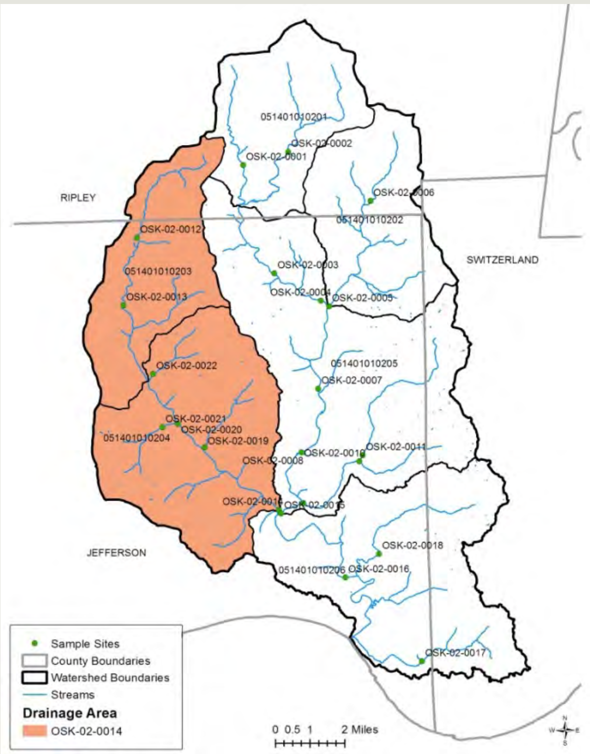


Figure 94: Pollutant Reductions: Headwaters West Fork Sub-Unit



HEADWATERS WEST FORK SUBUNIT

Site 14 – USGS gage drainage area ratio (1.67)

Reductions needed: N, P

Site 14 (29,440 acres)	90th Percentile Load (lbs. /yr.)	Target Load (lbs. /yr.)	Reduction Needed (lbs. /yr.)	Reduction Needed (%)
Nitrate-Nitrite	238,688	88,732	149,957	62.83
TKN	26,630	34,960	-	
TP	5,260	4,497	763	14.50
TSS	841,657	1,478,867	-	

Figure 95: Flow Duration - Nitrate

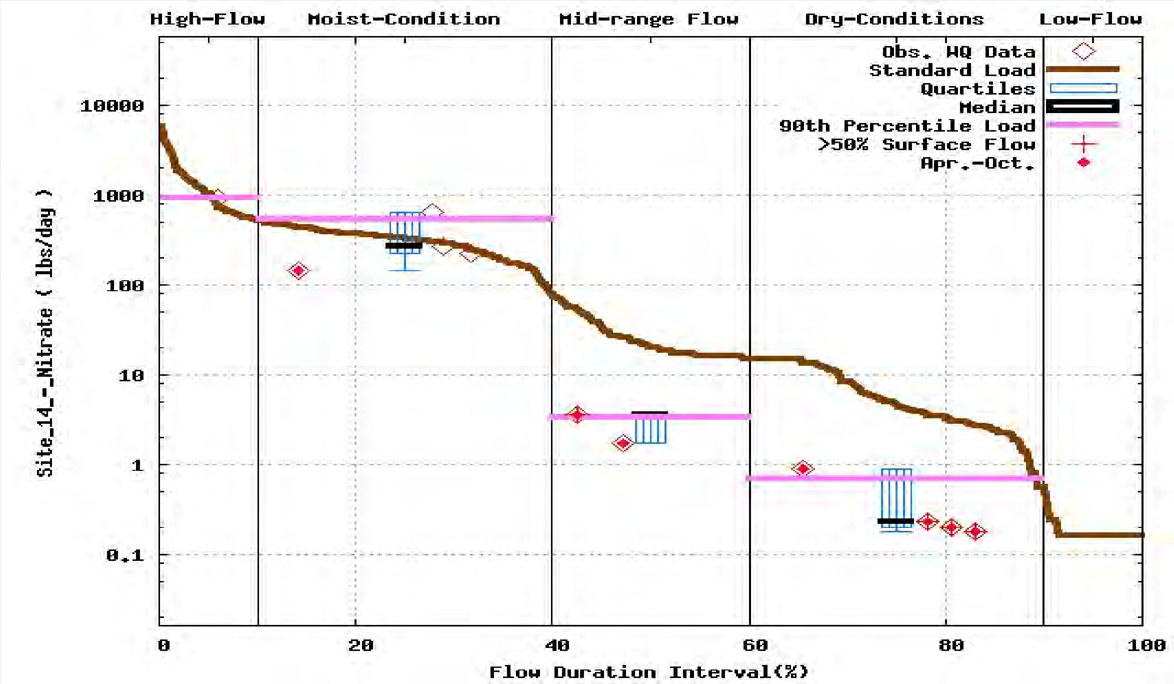


Figure 96: Flow Duration - TKN

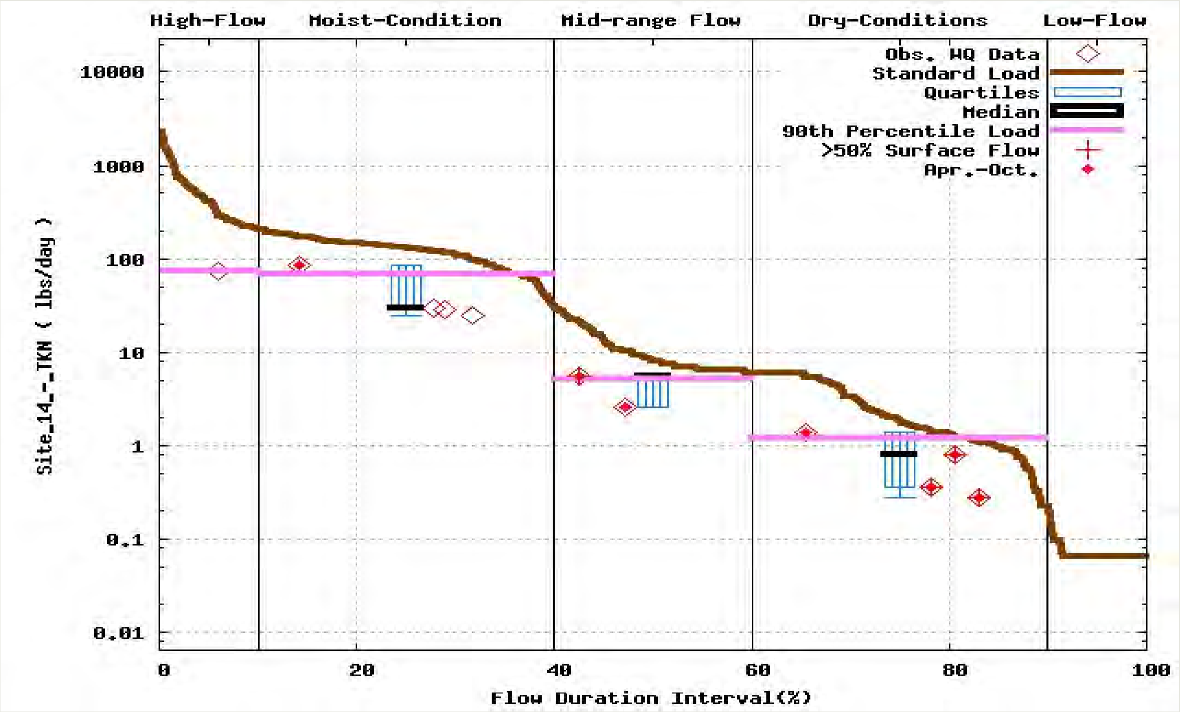


Figure 97: Flow Duration - TP

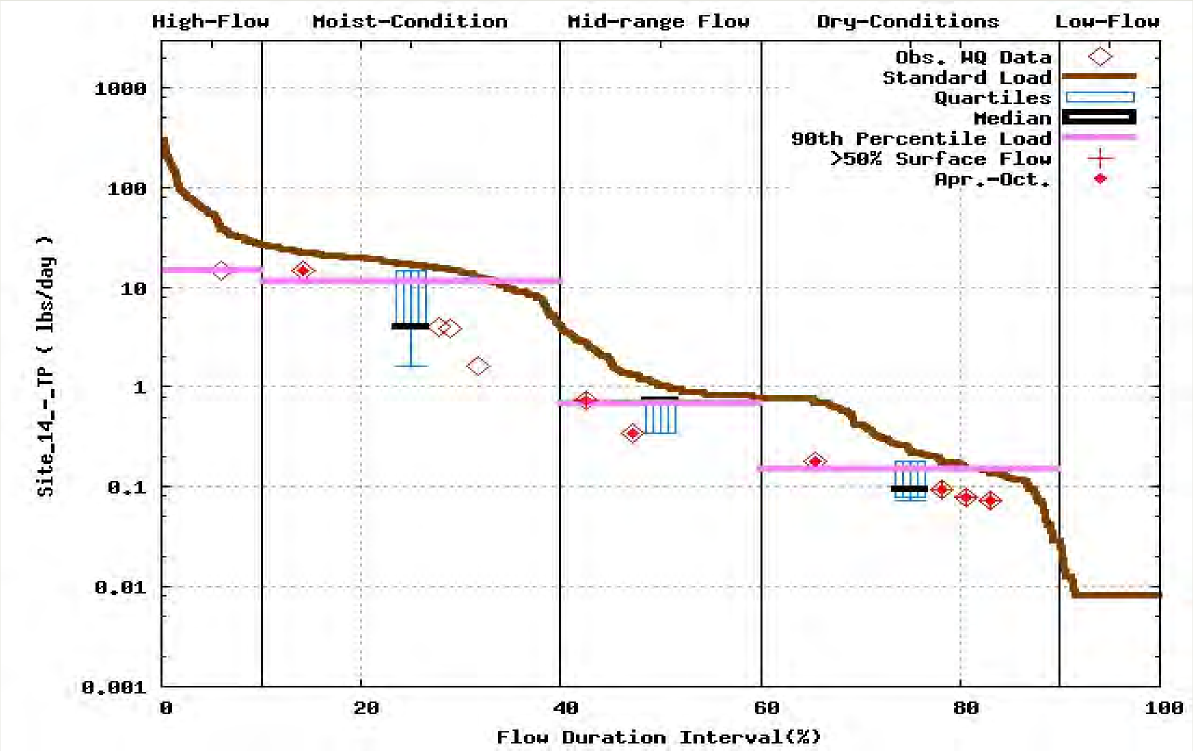


Figure 98: Flow Duration - TSS

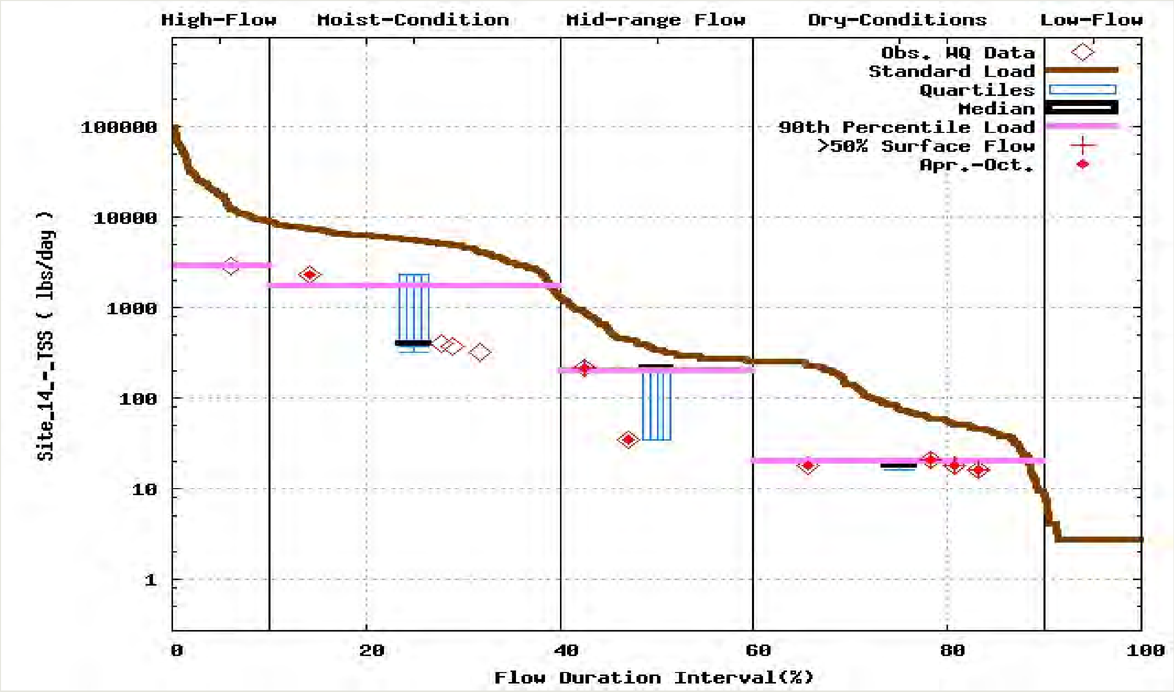
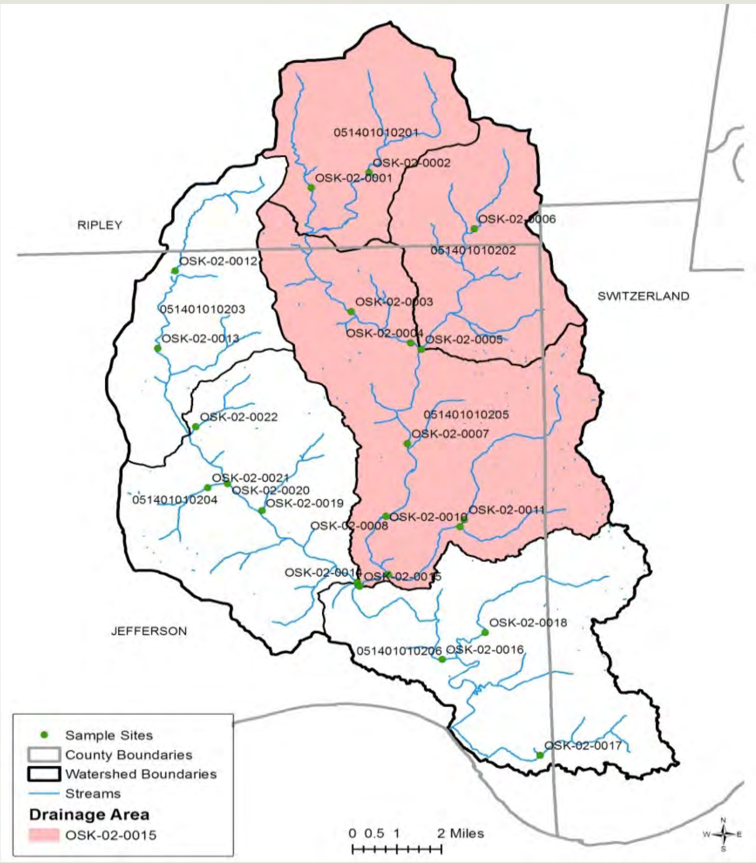


Figure 99: Pollutant Reductions: Vestal Branch/Wilson Fork/Brushy Fork Sub-Units



VESTAL BRANCH / WILSON FORK / BRUSHY FORK SUBUNITS

Site 15 – USGS gage drainage area ratio (2.76)

Reductions needed: N, P

Site 15 (48,570 acres)	90th Percentile Load (lbs. /yr.)	Target Load (lbs. /yr.)	Reduction Needed (lbs. /yr.)	Reduction Needed (%)
Nitrate -Nitrite	370,574	146,993	223,581	60.33
TKN	26,083	57,915	-	
TP	8,694	7,446	1,248	14.36
TSS	1,043,254	2,449,902	-	

Figure 100: Flow Duration - Nitrate

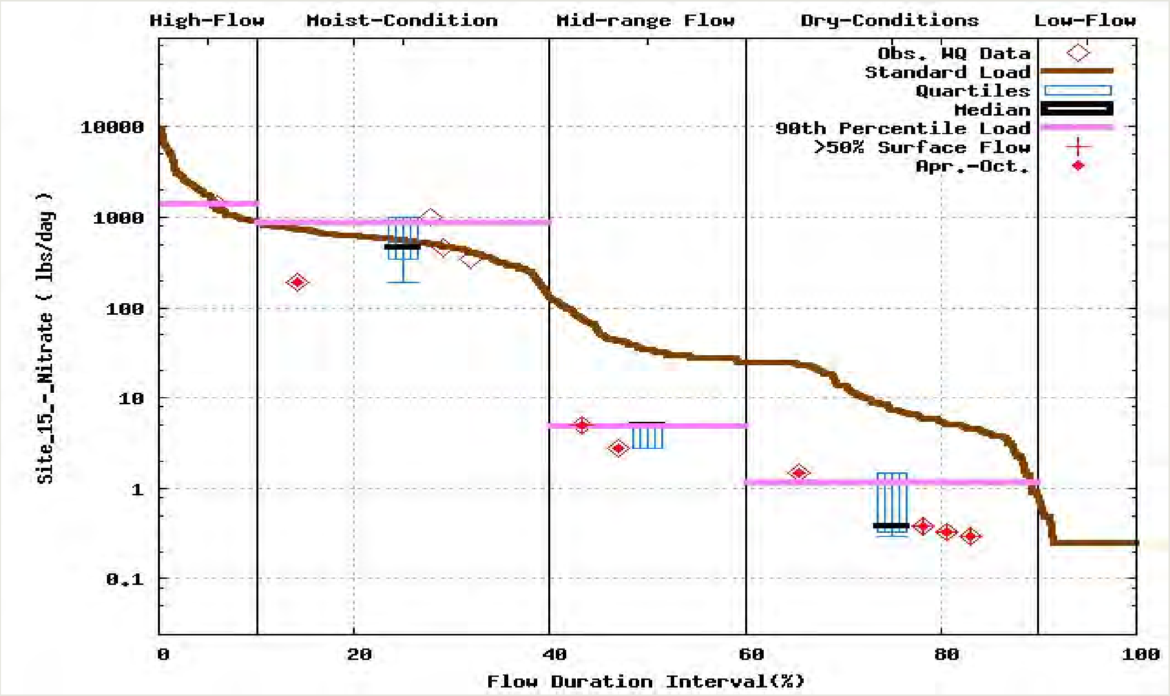


Figure 101: Flow Duration - TKN

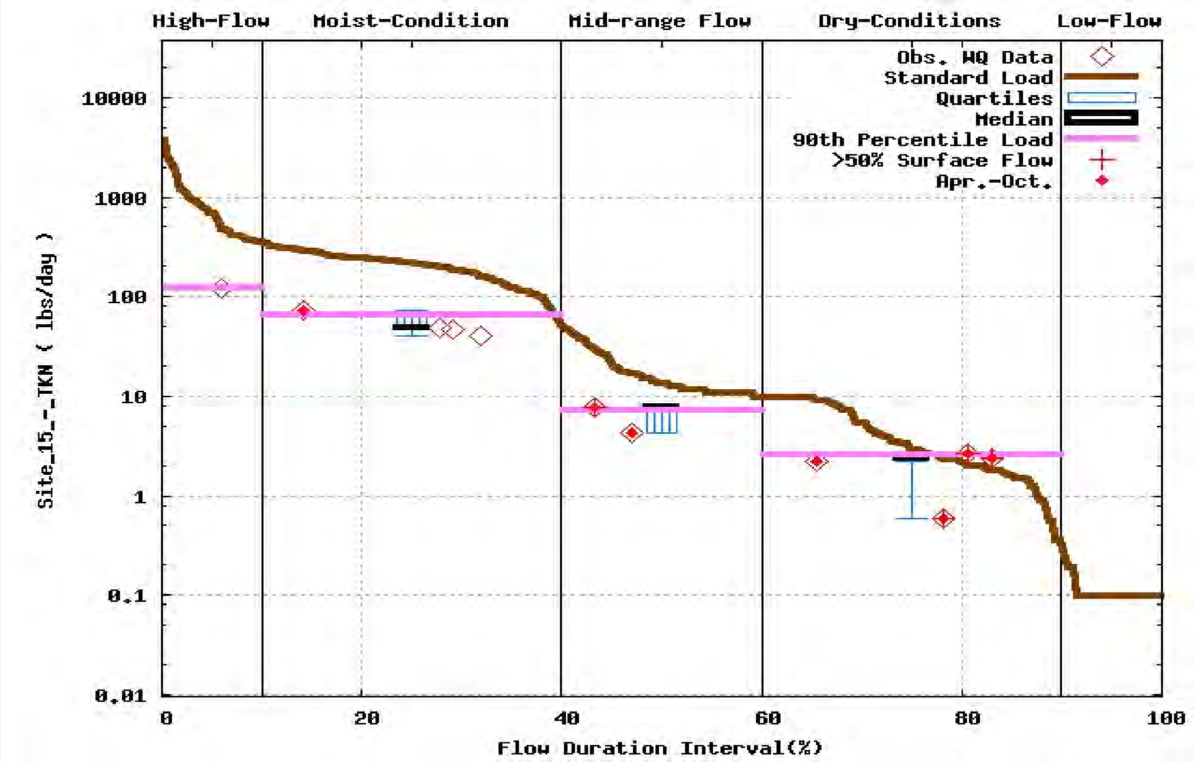


Figure 102: Flow Duration - TSS

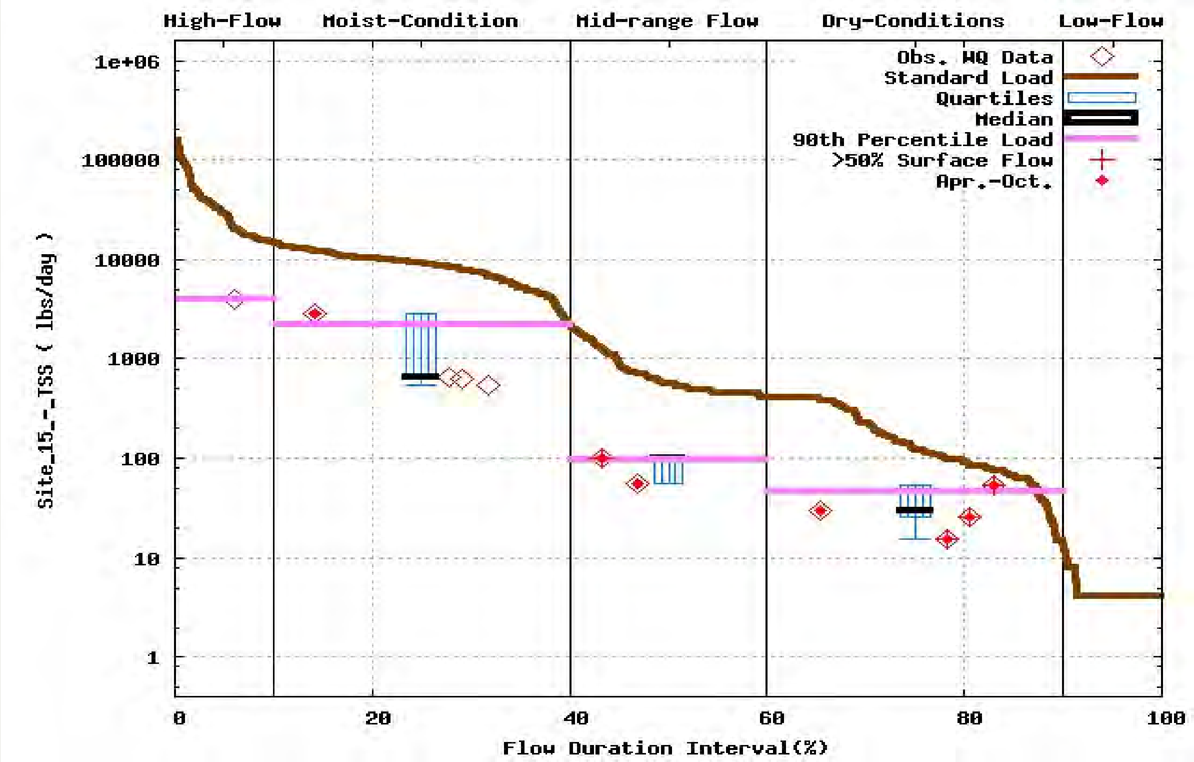


__Figure 103: Flow Duration - TP__

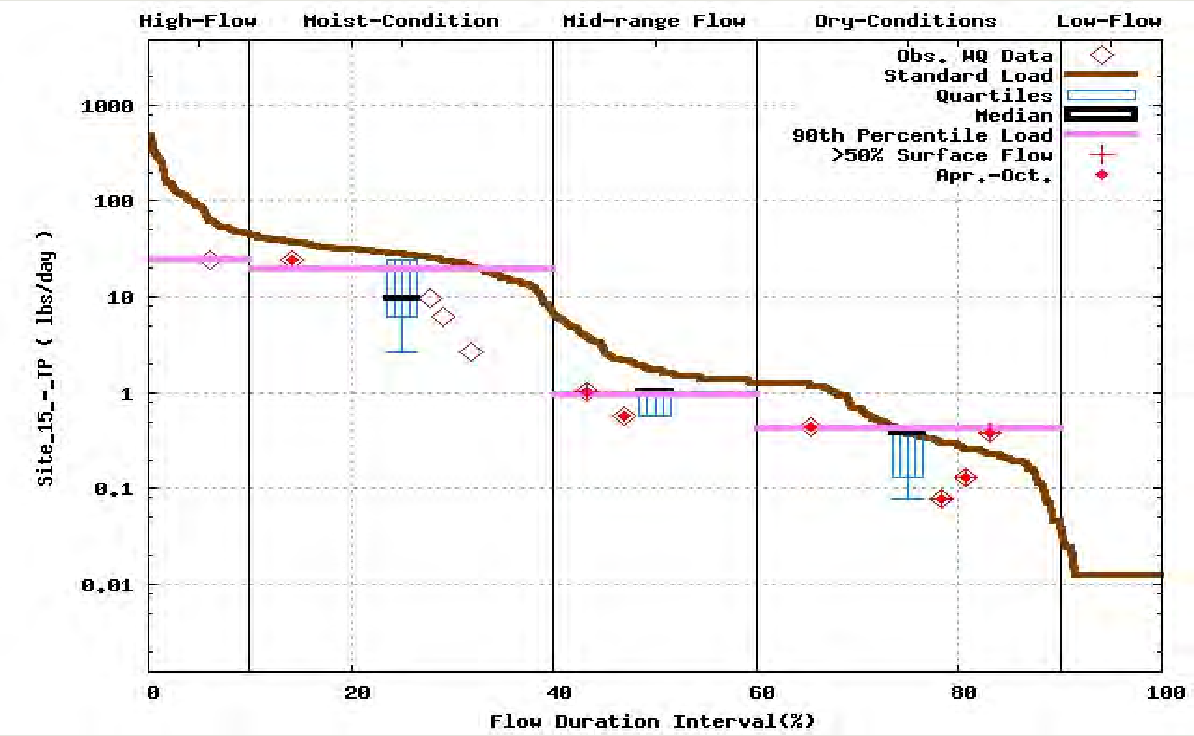
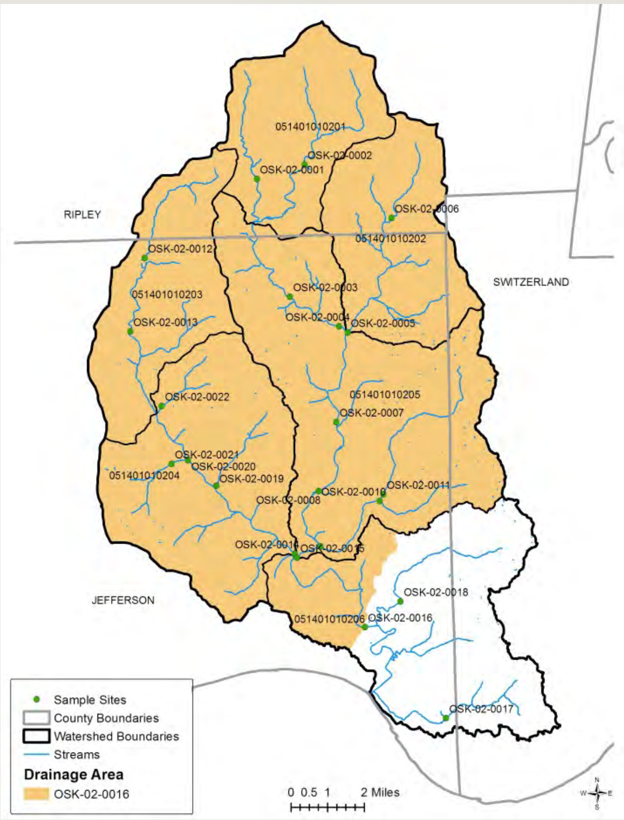


Figure 104: Pollutant Reductions: Vestal Branch/Wilson Fork/Headwaters West Fork/West Fork/Brushy Fork



VESTAL BRANCH / WILSON FORK / HEADWATERS WEST FORK / WEST FORK / BRUSHY FORK

Site 16 – USGS gage drainage area ratio (4.69)

most downstream site/outlet

Reductions needed: N, P, TSS

Site 16 (82,458 acres)	**90th Percentile Load (lbs. /yr.)**	**Target Load (lbs. /yr.)**	**Reduction Needed (lbs. /yr.)**	**Reduction Needed (%)**
Nitrate-Nitrite	608,280	249,784	358,496	58.94
TKN	88,637	98,415	-	
TP	23,623	12,655	10,968	46.43
TSS	5,347,878	4,163,051	1,184,827	22.16

Figure 105: Flow Duration - Nitrate

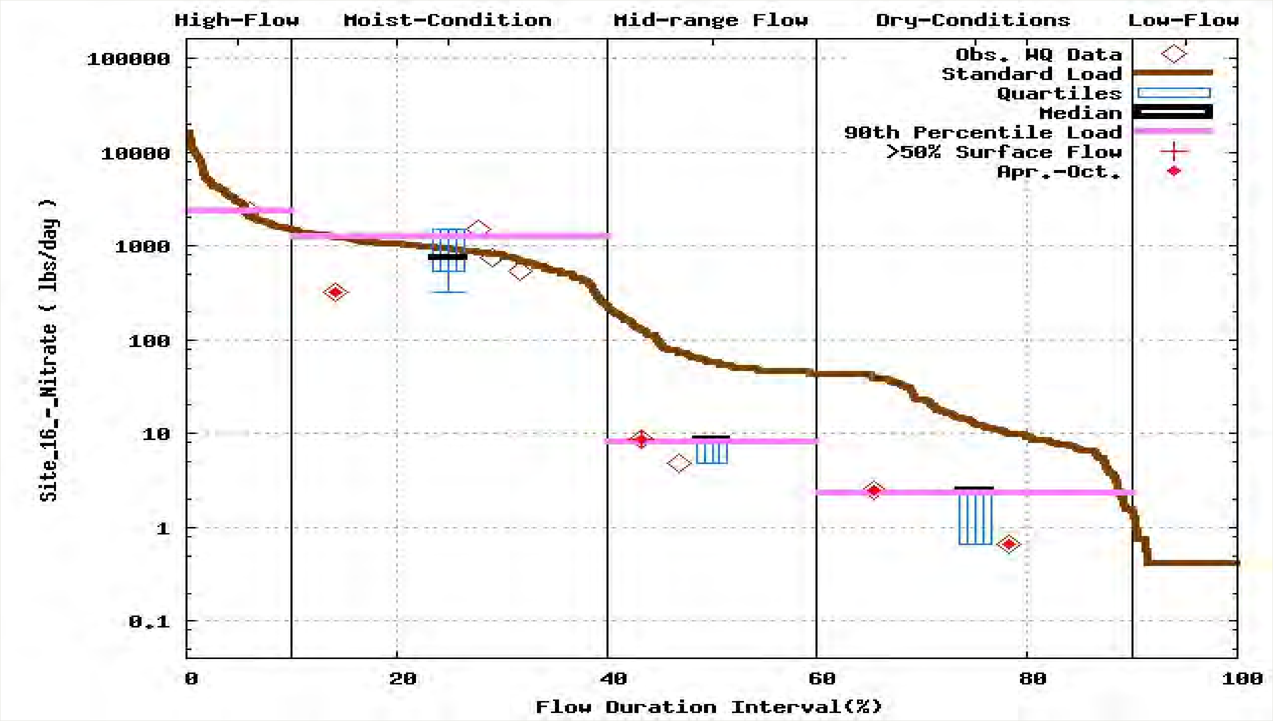


Figure 106: Flow Duration - TKN

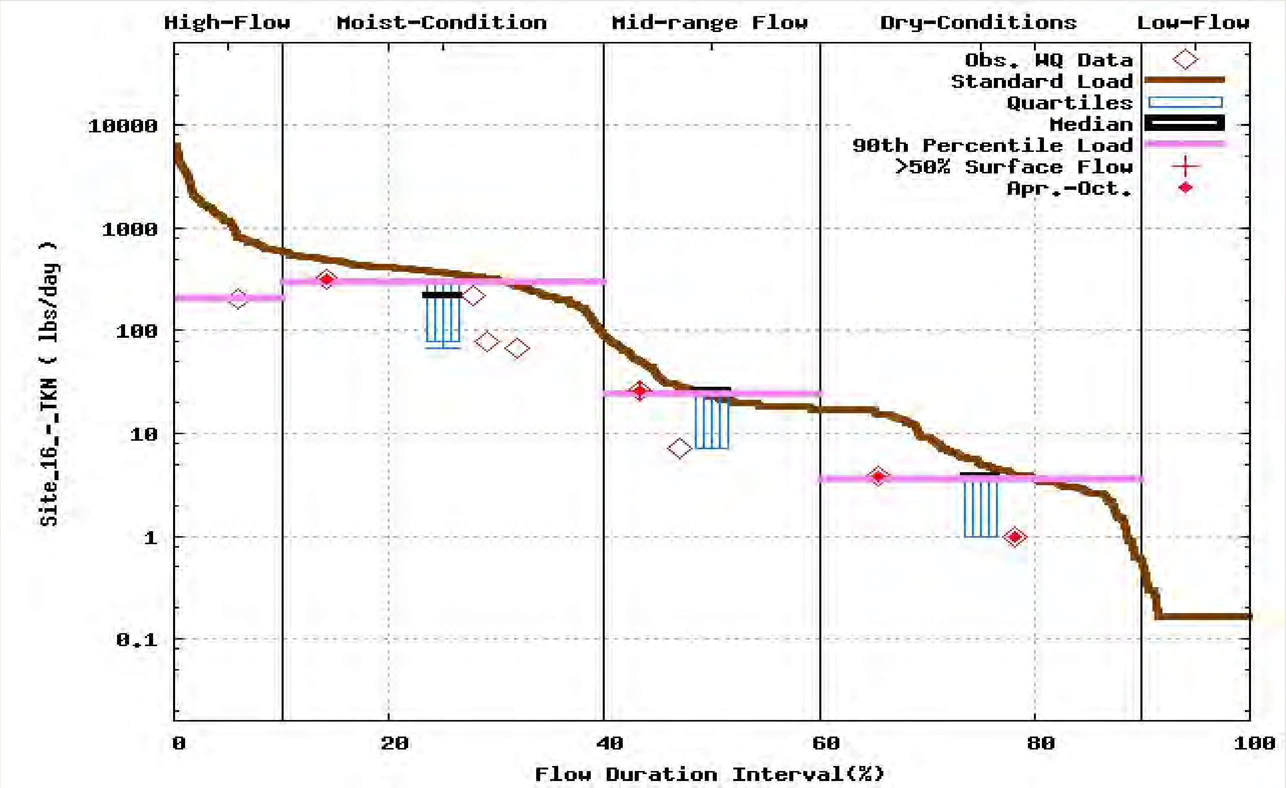


Figure 107: Flow Duration - TSS

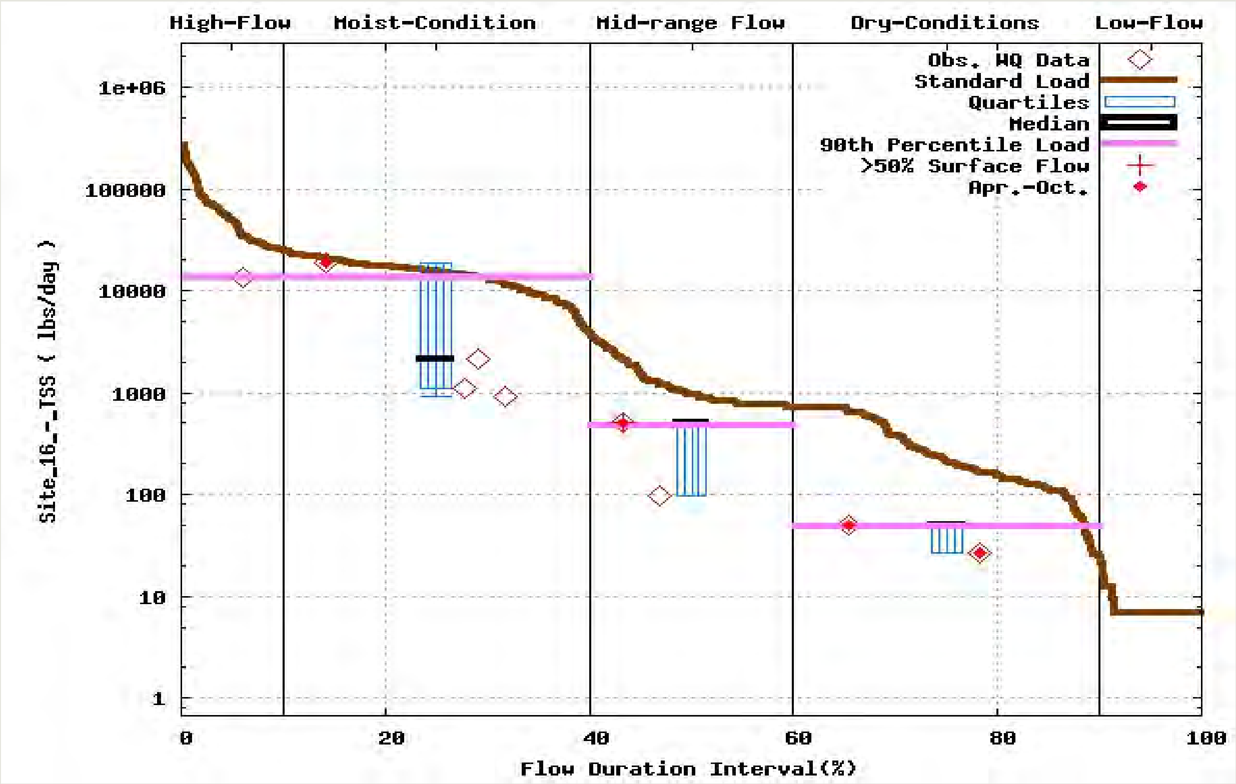
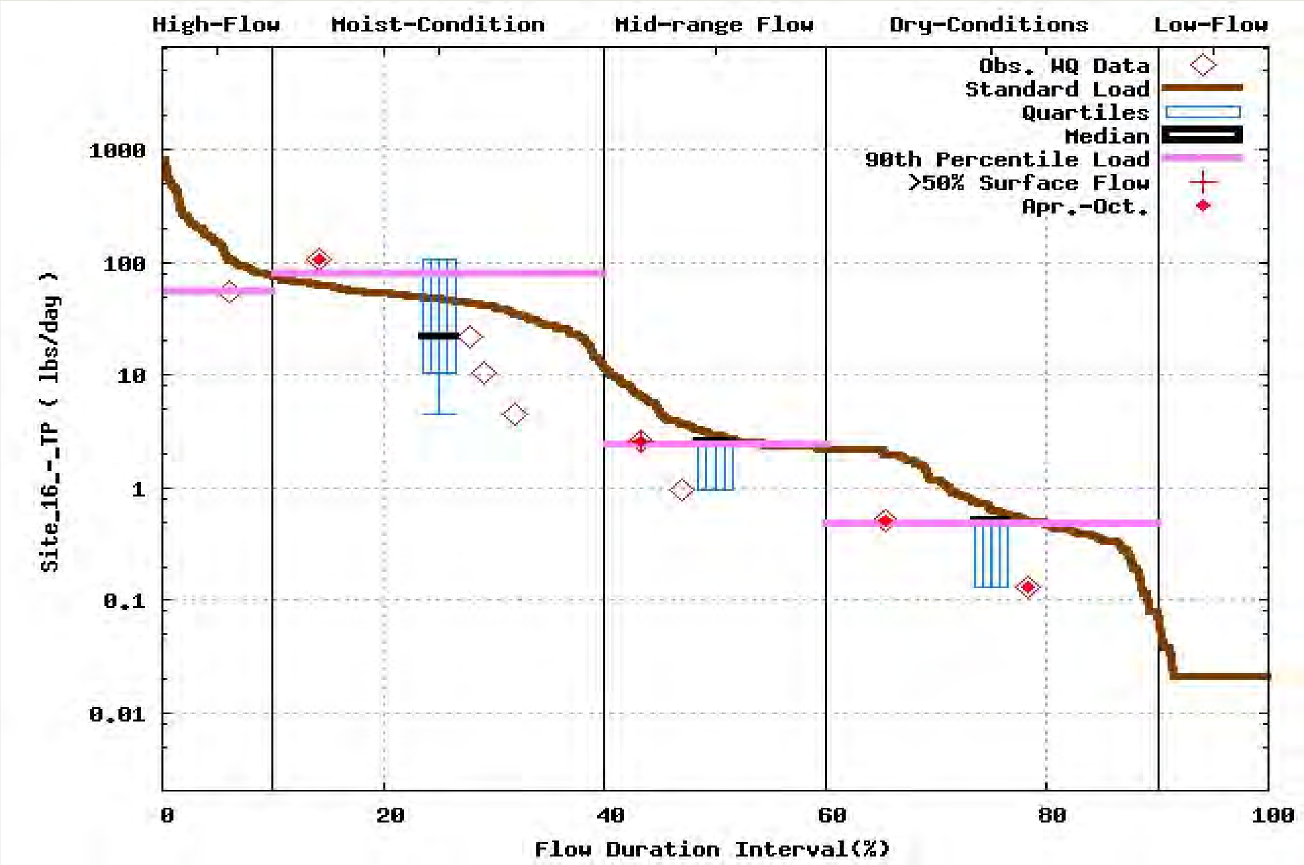


Figure 108: Flow Duration - TP



LOAD REDUCTION SUMMARY

The needed load reduction for N seemed to be concentrated in the sub watersheds of 201, 202, and 203. These subuntis have a high percentage of land in cultivated crops, 201- 46%, 202 – 18%, 203 – 31%. There was a needed reduction of Phosphorus in subunit 203 but no direct correlation to a resource concern was noted. Testing site #6 showed a significant reduction needed in phosphorus and total suspended solids and is located below areas identified with livestock in the water on the 2013 visual survey.

It is important to realize that in some cases prioritized critical areas may not correlate directly with subwatershed estimates for cumulative loads or loading per acre estimates. This can be attributed to a number of reasons. Current loadings are estimated for a single point in time and may not reflect the variation in actual, real world pollutant loading that occurs within each drainage over the course of the seasons. Another potential reason for this discrepancy is that downstream subwatersheds often “inherit” water quality impairments from more upstream drainages. So, if you were to focus all of your attention on the drainage area where the loading is documented, you still wouldn’t be addressing the true source of the loading which may lie in a completely different watershed. Again, we looked to add in characteristics such as land use and other variables that can help identify these areas.

Figure 109: Project Goals & Action Register
Sedimentation – Reduce the sediment level from 2,674 tons per year to 2,082 tons per year by the year 2020

Objective	BMP / Action Cost	Target Audience	Performed By / Assistance needed	Time Schedule and Milestones	Indicator
Problem Statement: There is a need to increase residue on cropland within the watershed					
Provide financial incentives to local landowners	Enlist 250 acres within watershed into **no-till** farming > $10,000 Utilize conservation equipment rentals available through local SWCD offices >$5,000 Install 5 acres of **grassed waterways** >$15,000 Co-sponsor annual No-Till breakfast with SWCD >$1,000 Seeding of 1000 acres of **cover crops** >$30,000 Utilize SWCD & HHH website to promote conservation efforts and field days	Agricultural landowners and operators	Watershed Coordinator, ISDA Resource Spec, SWCD Technician, NRCS District Conservationist	Have cost share program in place 2 months after funding. Promote BMP's in newsletters quarterly and at field days annually. Have 75% of BMP funding allocated the first year and remainder allocated the second year. Have 40% of funding spent on BMP implementation by the first year. Have all BMP's approved for cost share installed by 2019. .	Acres of conventional tillage converted to conservation tillage Number of times equipment is rented Reduction in sediment Acres of grassed waterways installed Acres of cover crops established.
Educate landowners about the effects of sedimentation on local water bodies and soil health.	Submit articles to local newspapers Use annual meetings/ field days/county fair to display the savings that can be attained for proper conservation no-till practices >$2,500	General Public	Watershed Coordinator	Ongoing Working with partners have an annual field day or workshop promoting BMP's	Number of people attending field days Number of articles submitted Number of people viewing displays Positive change in attitude about conservation tillage

Objective	BMP / Action Cost	Target Audience	Performed By / Assistance needed	Time Schedule and milestones	Indicator
Problem Statement: Unrestricted livestock access to the creek can lead to trampling of streambanks as livestock enter creek					
Provide financial incentives to local landowners	Installation of 5,000 feet of **fencing** to eliminate livestock from waterbodies >$15,000	Agricultural landowners and operators	Watershed Coordinator, ISDA Resource Spec, SWCD County technician, NRCS staff	Promote BMP's in newsletters quarterly and at field days annually. Have 75% of BMP funding allocated the first year and remainder allocated the second year. Have 40% of funding spent on BMP implementation by the first year. Have all BMP's approved for cost share installed by 2019	Number of head of cattle fenced out of waterbodies Number of alternative watering systems installed Number of acres of riparian buffer strips planted Reduction of sediment
	Installation of 15 **alternative watering systems** >$45,000				
	Plant 25 acres of **buffers** around critical areas. >$5,000				

Objective	BMP / Action - Cost	Target Audience	Performed By / Assistance needed	Time Schedule and milestones	Indicator
Problem Statement: Overgrazed pasture and weak hayland stands are adding to the sediment load of Indian-Kentuck					
Provide financial incentives to local landowners	Reseeding of 600 acres of **hayland & pasture i**ncluding cool and warm season grasses. >$54,000 Installation of 5000 foot of **internal fencing** for pasture rotation. >$15,000	Agricultural landowners and operators	Watershed Coordinator, ISDA Resource Spec, SWCD County technician, NRCS staff	Promote BMP's in newsletters quarterly and at field days annually. Have 75% of BMP funding allocated the first year and remainder allocated the second year. Have 40% of funding spent on BMP implementation by the first year. Have all BMP's identified installed by 2019	Number of acres re-seeded. Number of feet of internal fencing installed Reduction of sediment

Nutrient Goal – Decrease the Nitrogen load from 608,280 lbs. per year to 249,784 lbs. per year by 2022. Decrease the Phosphorus load from 23,623 lbs. per year to 12,655 lbs. per year by 2022.

Objective	BMP / Action - Cost	Target Audience	Performed By / Assistance needed	Time Schedule and milestones	Indicator
Problem Statement: Lack of riparian buffers can cause warming of the stream and low dissolved oxygen levels. Livestock waste in streams can lead to excess nutrients in waterbodies which may lead to eutrophication					
Offer financial assistance to landowners through cost-share programs	Implement **rotational grazing systems** ($ see above)	Agricultural landowners and operators	Watershed Coordinator, ISDA Resource Spec, SWCD County technician, NRCS staff, IDEM	Promote BMP's in newsletters quarterly and at field days annually. Have 75% of BMP funding allocated the first year and remainder allocated the second year. Have 40% of funding spent on BMP implementation by the first year. Have all BMP's identified installed by 2019 Request IDEM to complete water quality monitoring by 2020 to determine if there has been an improvement in water quality	Number of feet of interior fencing installed Number of landowners signing up for cost share Number of acres of riparian buffers Increase in conservation tillage
	Establish 10 acres of **riparian buffers** > $5,000				
	Promote **conservation tillage** ($ see above)				
	Install 5 heavy use protection areas **(HUAP's)** in conjunction with alternative water systems or buffers. >$15,000				Number of HUAP's installed
	Establishment of **filter strips**				Acres of filter strips established

E. Coli Goal - Reduce level of E.coli in stream to state standard of 235 colonies or below within 8 years (2022)

Objective	BMP / Action – Cost	Target Audience	Performed By / Assistance needed	Time Schedule and milestones	Indicator
Problem Statement: Unrestricted livestock access to waterbodies can lead to an increase in pathogens from animal waste that may cause health problems in humans.					
Provide financial incentives to local landowners	**Fencing** of 250 head of livestock from waterbodies ($ see above) Install 5 heavy use protection areas **(HUAP's)** in conjunction with alternative water systems or buffers. >$15,000 Installation of 15 **alternative watering systems** ($ see above) Plant 25 acres of **buffer strips** ($ see above)	Agricultural landowners and operators	Watershed Coordinator, ISDA Resource Spec, SWCD County technician, NRCS staff	Promote BMP's in newsletters quarterly and at field days annually. Have 75% of BMP funding allocated the first year and remainder allocated the second year. Have 40% of funding spent on BMP implementation by the first year. Have all BMP's identified installed by 2019 Delisting of Indian Kentuck Creek from 303d list by 2022	Number of head of cattle fenced out Number of HUAP's installed Number of alternative watering systems installed Number of acres of buffer strips planted Reduction in E.coli levels and streams delisted from 303d list

E. Coli Goal - Reduce level of E.coli in stream to state standard of 235 colonies or below within 8 years (2022)

Objective	BMP / Action – Cost	Target Audience	Performed By / Assistance needed	Time Schedule and milestones	Indicator
Problem Statement: Lack of proper septic systems or improper maintenance of existing septic systems leads to system failure causing pathogens to enter nearby waterbodies posing a health risk to humans.					
Educate community about septic system issues	Assist Health Department with outreach program to assist homeowners by providing educational programs. <$5,000	Anyone with issues concerning septic installation & maintenance	Watershed Coordinator, Health Department personnel	Work with partners to have a field day or workshop in 2017 promoting new septic field technology. In 2017 distribute reminder cards to watershed residents encouraging them to check their septic every 3-5 years By 2022 have Indian Kentuck Creek off of 303d list	Number of homeowners and contractors attending workshops and new technology adopted.
Problem Statement: There are sites in the uplands and streams of the Indian-Kentuck Watershed that are used for dumping sites.					
Educate community about recycling.	Work with the Solid Waste District to develop an outreach program which may include amnesty week for those with TV's, tires and agricultural chemicals to dispose of. <$5,000	Anyone within the Indian-Kentuck Watershed	Watershed Coordinator, Regional Solid Waste District	Working with partners have an annual event promoting recycling.	Number of items received by Solid Waste.

Steering Committee members identified a generalized list of Best Management Practices (page 119) which could be used within the Indian Kentuck Watershed to achieve the water quality goals described above. Please note that this list is not all-inclusive and other practices may come into play in future implementation programs as there are improvements in technology and land management strategies. This list is heavily focused on practices for agricultural-based rural land which is by far the most common land use within the watershed.

CRITICAL AREAS OF THE INDIAN-KENTUCK WATERSHED

Critical areas are defined by IDEM as those areas that have been identified through historical studies, land use information, and water quality data, in the project area as needing implementation efforts to improve current water quality or that will mitigate the impact of potential sources of NPS to protect water quality. Identifying critical areas and goals to address those critical areas will focus efforts in the watershed on the areas that will have the greatest impact on improving water quality. This section will identify the critical areas located within the Indian Kentuck Watershed project area.

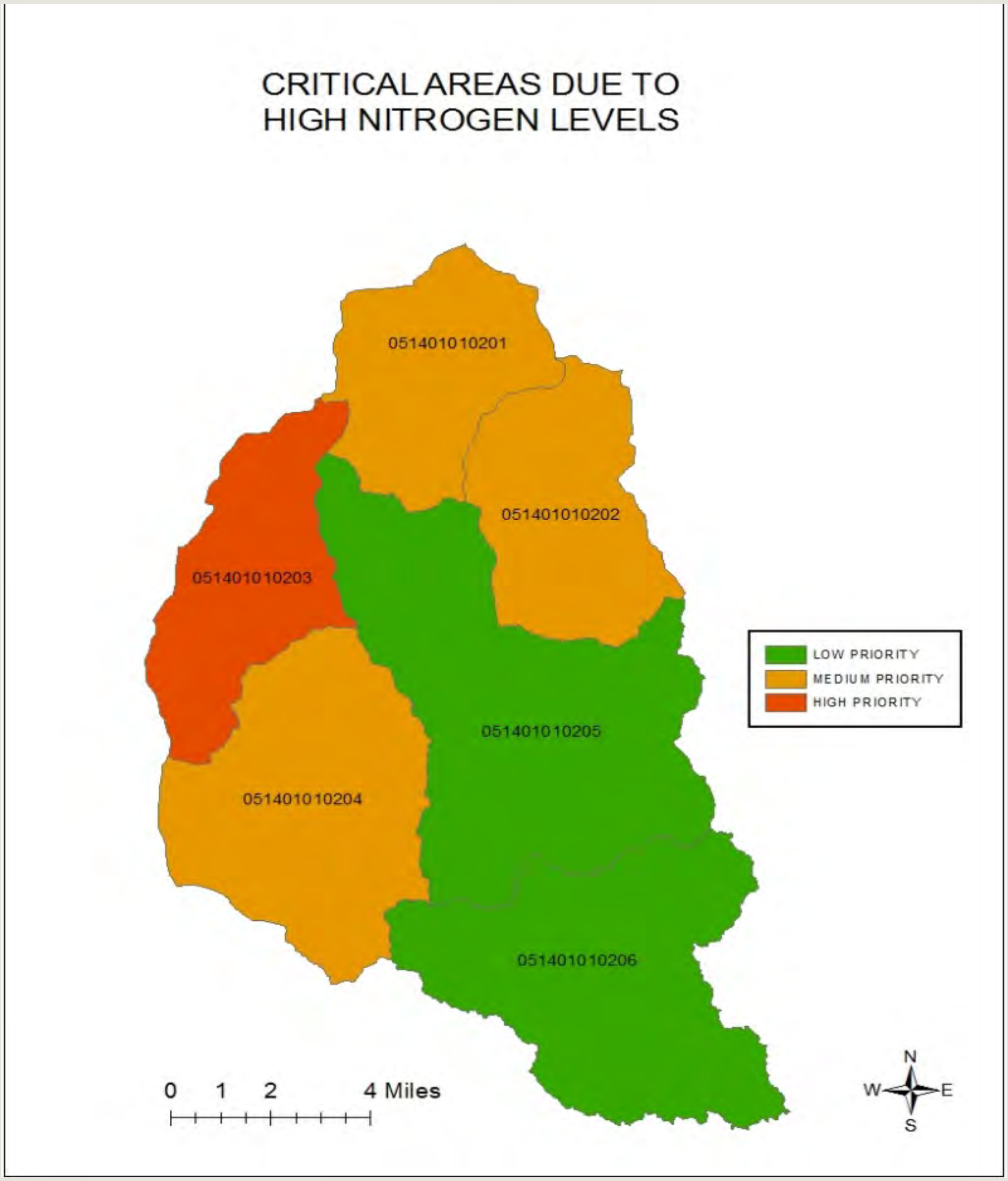
The map in figure 110 shows sub-units of the Indian Kentuck Watershed area, IDEM water quality testing data and visual assessments that exceeded standards set by the IKW Steering Committee.

Figure 110: Pollution Parameters Identified in the Subunits of Indian Kentuck Watershed

CRITICAL AREAS DUE TO HIGH NITROGEN LEVELS

The subunit of 051401010203 has been identified as critical due to various factors including results from the visual survey which indicated there was insufficient residue (<30%) in many crop fields to completely control erosion. This subunit also had nitrate + nitrite values that exceeded EPA standards of <1.5 mg / L. This subunit also was noted as having livestock in water which may contribute to high nitrogen levels.

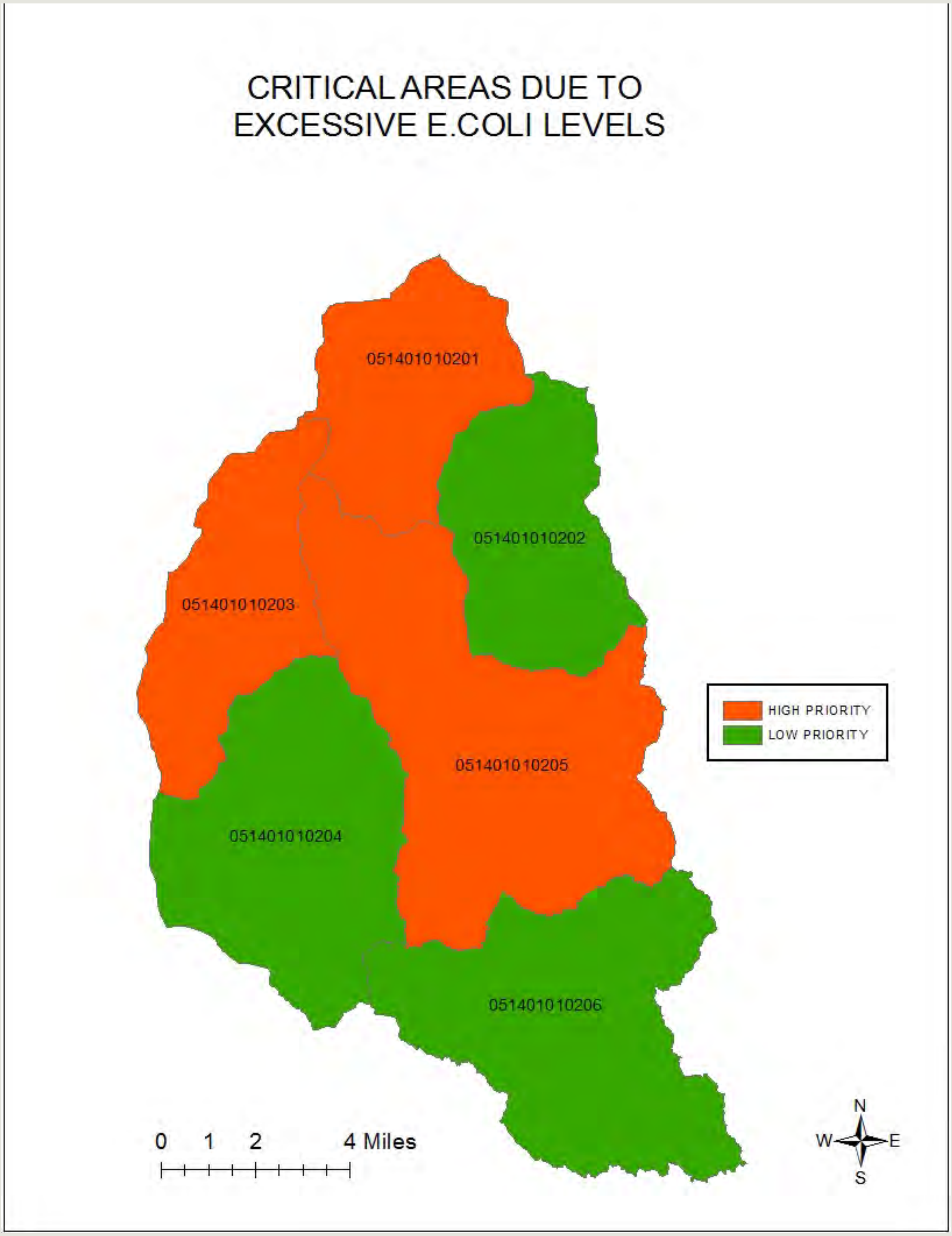
Figure 111: Critical Areas – High Nitrogen Levels



CRITICAL AREAS DUE TO HIGH E. COLI LEVELS

The subunits of 051401010201, 051401010203, and 051401010205 have been identified as critical areas due to E.coli. During sampling and testing of sites within Indian Kentuck subunits 051401010201 and 051401010203 were found to have E.coli levels that exceeded the state standard of 125 cfu / 100 ml. Subunit 051401010205 was identified as a critical area due to the 303d designation given by IDEM in 2012. The 303d designation was given due to excessive E.coli levels and impaired biotic communities within the stream at that time.

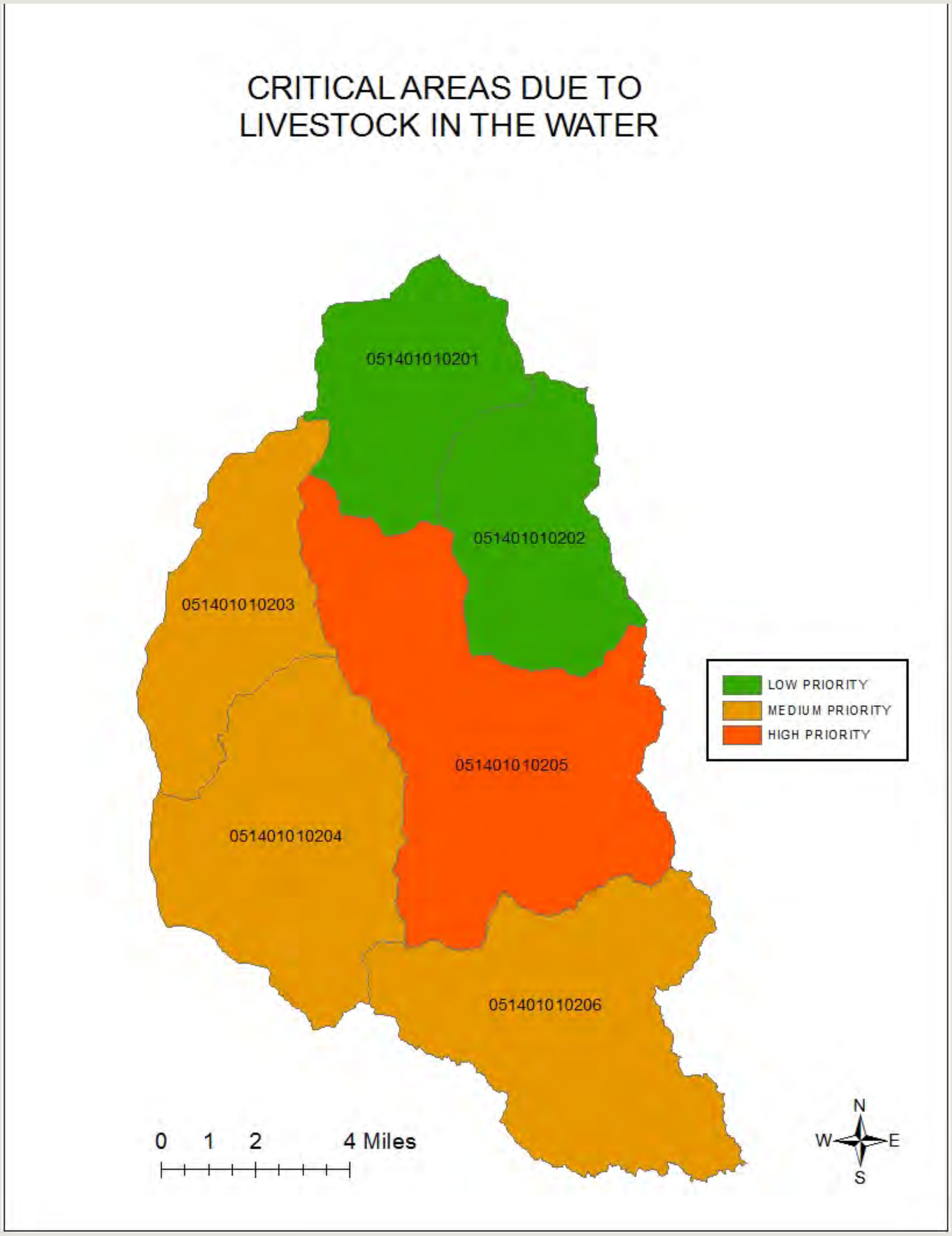
Figure 112: Critical Areas – Excessive E. coli Levels



CRITICAL AREA DUE TO LIVESTOCK IN WATER

The subunit of 051401010205 has been identified as critical due to livestock in water. This is based on the visual survey of the watershed. Subunits 0514010103, 051401010204, and 051401010206 also had livestock with access to streams but were not as high as subunit 205. Livestock with access to water in subunit 205 may contribute to high E.coli levels as noted with the streams 303d designation.

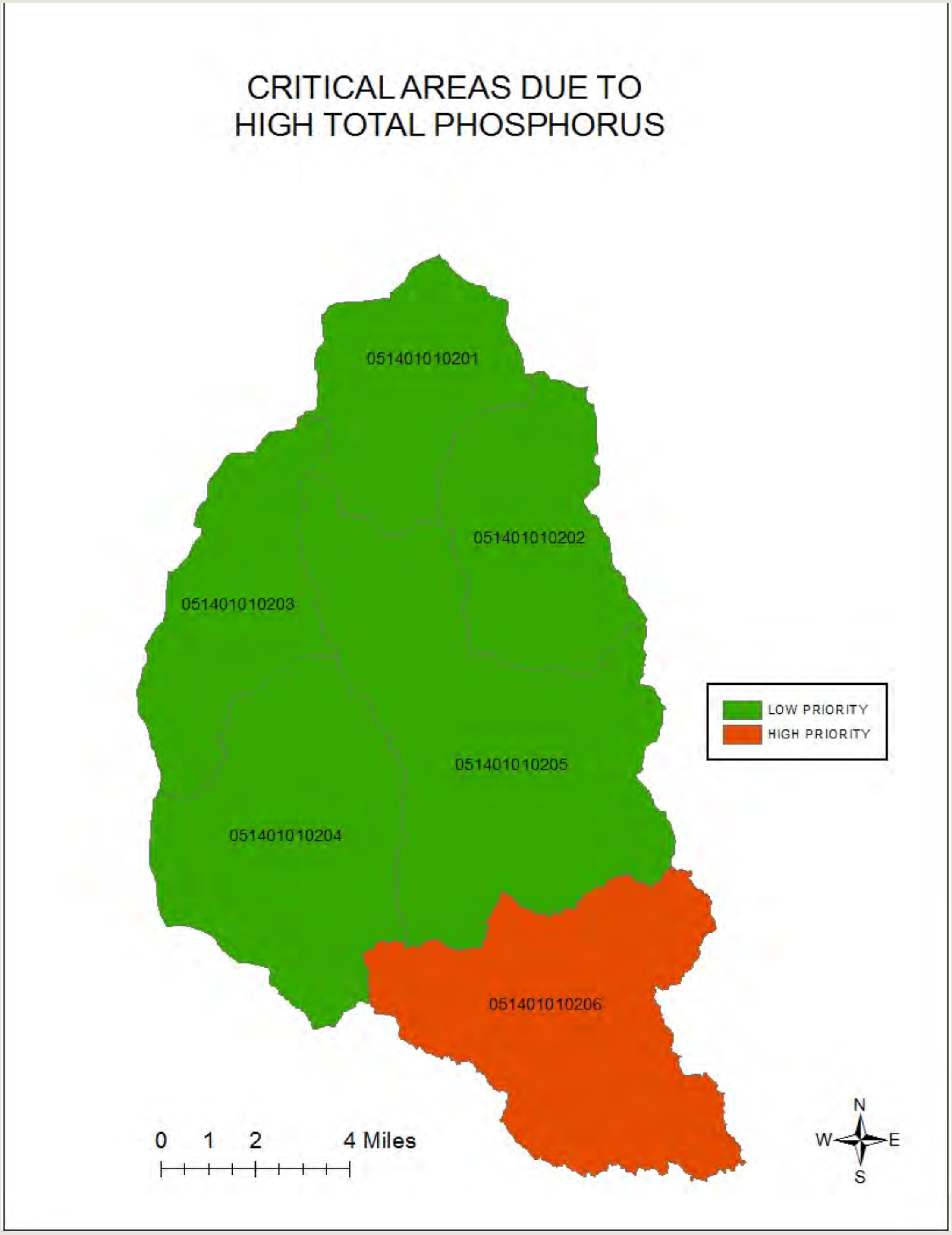
Figure 113: Critical Areas – Livestock in Water



CRITICAL AREAS DUE TO HIGH TOTAL PHOSPHORUS LEVELS

The subunit of 051401010206 was identified as critical due to the high level of total phosphorus noted during water testing. The test indicated total phosphorus levels exceeding the EPA standard of .076 mg /L .This could be due to septic systems not functioning properly on some of the steeper sites where homes are located. In these areas soils can be shallow with limiting layers of fragmented rock.

Figure114: Critical Areas – High Total Phosporus



PRIORITY AREAS FOR RIPARIAN BUFFER STRIPS ALONG STREAMS

Figure 115: Priority Areas for Riparian Buffer Strips

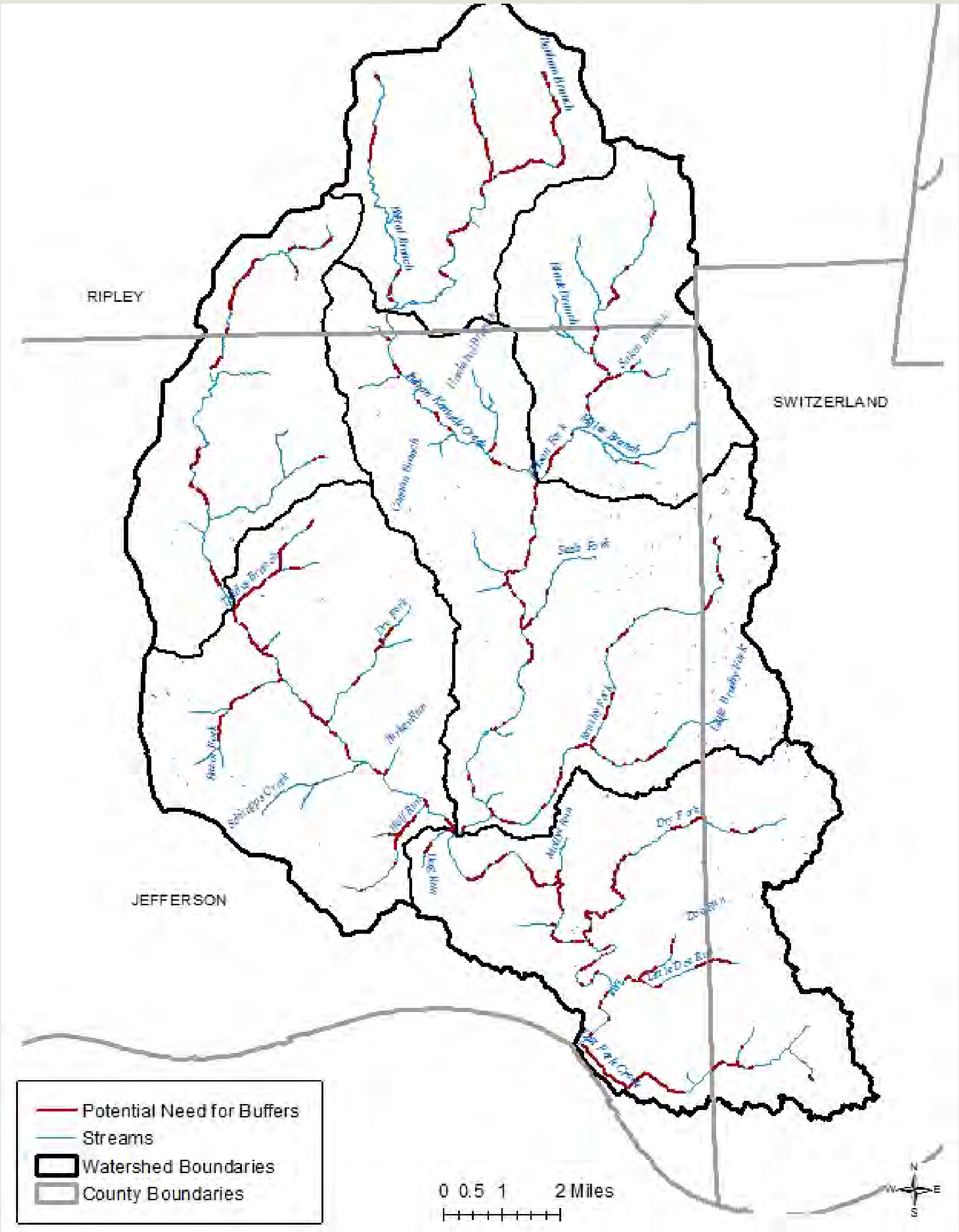


Figure 115 shows buffer areas along streams that are considered priority areas, these are highlighted in red. To be considered a priority area the buffer of trees and grasses have a total distance from the center of the stream to buffer edge of less than 150 feet.

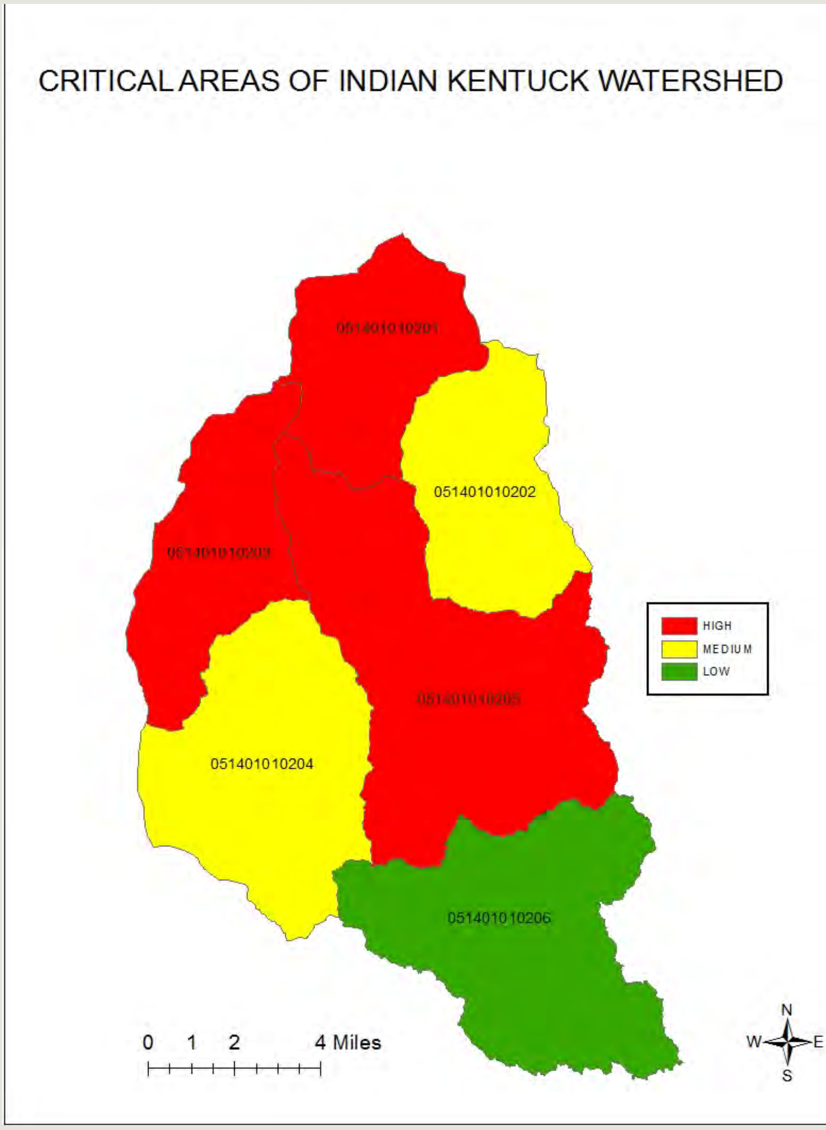
Riparian buffers are important for good water quality. Riparian zones help prevent sediment, nitrogen, phosphorus, pesticides and other pollutants from reaching a stream. Riparian buffers are most effective at improving water quality when they include a native grass or herbaceous filter strip along with deep rooted trees and shrubs along the stream.

Overhanging riparian vegetation keeps streams cool, which can be important for fish and other species.

CRITICAL AREA SUMMARY

The Indian Kentuck Steering Committee looked closely at all available data that has been gathered throughout this watershed investigation and determined that several areas in particular are contributing to NPS and the degradation of water quality within the watershed. Therefore, those areas were deemed critical by the steering committee and are outlined below. Reasons are listed in bullet form for each subunit.

Figure 116: Critical Areas of IKW



Vestal Branch (201)

- **Impaired Biotic Community**
- **Nutrient Impairment**
- **Exceeded State Standard E-coli Count**
- **Exceeded EPA Standard for Turbidity**
- **Insufficient Crop Residue**
- **Overgrazed Pasture**
- **Trash**

Wilson Fork (202)

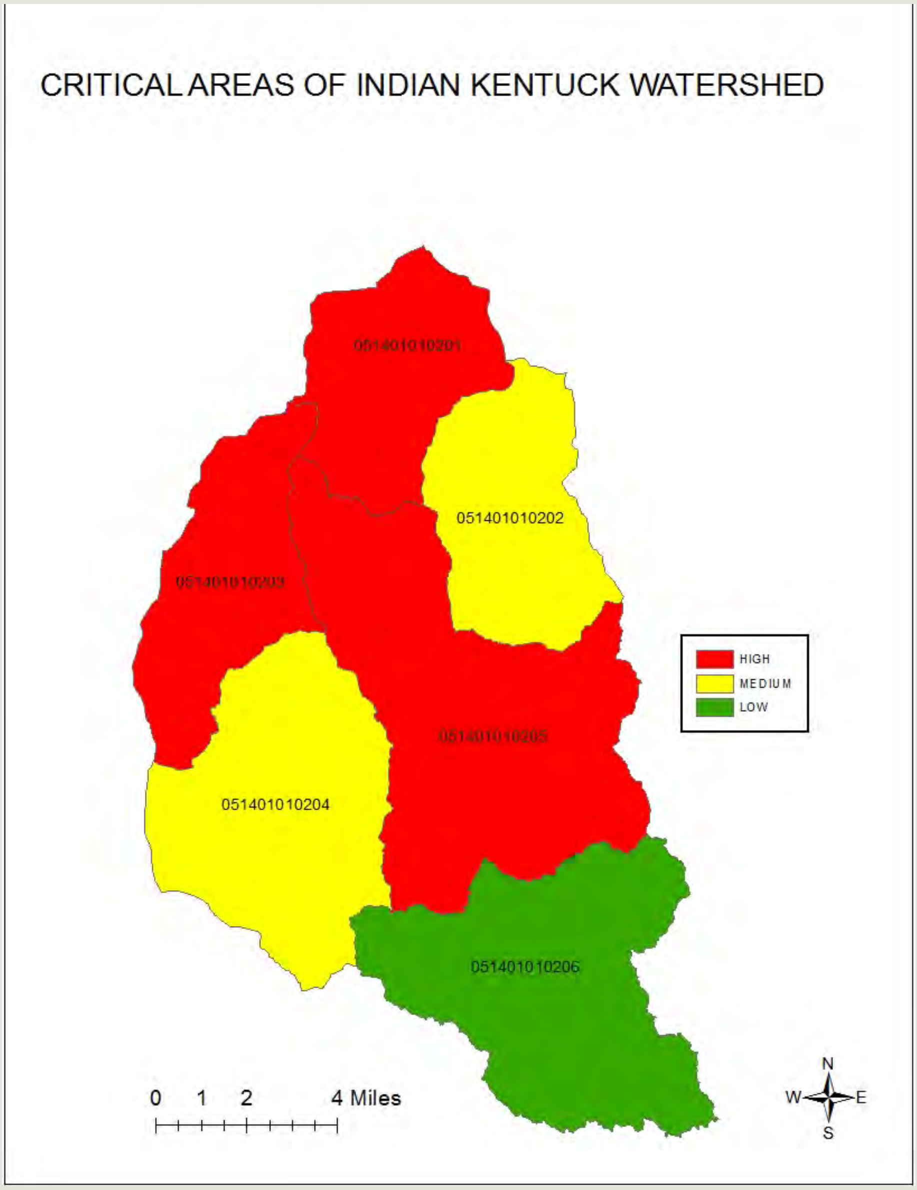
- **Impaired Biotic Community**
- **Insufficient Crop Residue**
- **Overgrazed Pasture**

Headwaters West Fork (203)

- **Impaired Biotic Community**
- **Nutrient Impairment**
- **Exceeded State Standard E-coli Count**
- **Exceeded EPA Standard for Turbidity**
- **Insufficient Crop Residue**
- **Weak Hayland Stands**

CRITICAL AREA SUMMARY cont.

Figure 117: Critical Areas of IKW



West Fork (204)

- **Nutrient Impairment**
- **Insufficient Crop Residue**
- **Overgrazed Pasture**
- **Weak Hayland Stands**
- **Insufficient Stream Buffers**

Brushy Fork (205)

- **Impaired Biotic Community**
- **Nutrient Impairment**
- **303 d Designation by IDEM**
- **Insufficient Crop Residue**
- **Overgazed Pasture**
- **Weak Hayland Stands**
- **Livestock in Water**
- **Livestock in Woods**
- **Trash**

Doe Run (206)

- **Exceeded EPA Standard for Phosphorus**
- **Overgrazed Pasture**
- **Weak Hayland Stands**
- **Trash**

ESTIMATED LOAD REDUCTIONS FROM BMP IMPLEMENTATION

The IDEM/U.S. EPA Region 5 Pollutant Load Reduction Model was used to estimate nitrogen, phosphorus, and sediment load reduction based on the Best Management Practice used. It is important to remember that the BMPs listed in Figure 118 will have a cumulative effect on pollution load reductions the longer the BMP is utilized.

Figure 118: Effects of BMPs on Load Reductions

BMP	NUMBER	LBS/ YR NITROGEN REDUCTION	LBS / YR PHOSPHORUS REDUCTION	T / YR SEDIMENT REDUCTION
Conservation Tillage	250 Acs.	3138	1569	1626
Grassed Waterways	5 Acs	114	58	60
Cover Crops	1000 Acs	10927	5463	5468
Fencing out of stream	5000 Ft.	3531	790	-
Alternative Watering System	15	3531	790	-
Buffers	25 Acs	485	246	246
Reseeding	600 Acs	6900	3449	3497
Interior fencing for rotational grazing	5000 Ft	2567	1283	1337
Heavy Use Area Protection	5	3074	288	-
Riparian Buffers	10 Acs	173	87	97

TRACKING EFFECTIVENESS

The Indian Kentuck Steering Committee intends to continue the visual assessment annually. The hope is to see improvement at the 62 preselected sites. Any implemented Best Management Practices will be mapped and modeled for their respective load reductions.

Once the implementation phase of the project is in place the IKW Steering Committee wants all funds to be allocated within 18 months. If needed the cost share rate will be adjusted to accomplish this.

Social data will also be used to help track progress towards our goals and objectives. All attendees of field days, workshops, or informational meetings will be given an end-of-session questionnaire to evaluate any immediate changes in knowledge and awareness.

It would be helpful if IDEM would continue water quality monitoring after implementation of conservation practices on the land. This would need to be completed by 2020.

FUTURE WMP ACTIVITY

Future activities and phases of the Indian Kentuck Watershed project is for the Steering Committee to develop a cost-share program that will include, at a minimum, those management measures outlined in this WMP, and the various incentive levels that will be used to encourage the adoption of those management practices. Funding for this program will be applied for through a 319 grant application to IDEM in September of 2014. The Steering Committee will work closely with all Conservation Districts located within the project area, as well as other partners listed in this management plan to make sure cost-share recommendations are realistic for the demographics of the area, and to utilize their help for promoting the cost share program.

As data is collected during the conservation planning process the WMP will be re-evaluated by the IKW Steering Committee and Historic Hoosier Hills if there is significant changes are indicated. These revisions will be discussed with IDEM personnel before taking place. Changes in the WMP may also be indicated as additional information is obtained through public input using surveys or public meetings.

Educational activities will be a major component of the implementation phase of this project. Activities will include workshops, field days, and public meetings. Newsletters and electronic media will be included in the educational component of this project.

The IKW project will introduce the cost-share program to the public through at least one public meeting held after cost share implementation funds are approved. The meetings will be advertised through local media outlets including newspapers, SWCD, NRCS, and FSA offices. Other means of advertisement will be pursued as well.

LIST OF BEST MANAGEMENT PRACTICES

Cover Crop – Grasses, legumes, forbs, or other herbaceous plants established for seasonal cover and conservational purposes (NRCS Code 340).

Critical Area Planting – To stabilize the soil, reduce damages from sediment and runoff to downstream areas, and improve wildlife habitat and visual resources (NRCS Code 342).

Fence – A constructed barrier to keep people and animals from entering the water body (NRCS Code 382).

Filter Strip – A strip or area of herbaceous vegetation situated between cropland, grazing land, or disturbed land (including forest land) and environmentally sensitive areas (NRCS Code 393).

Grade Stabilization – In areas where the concentration and flow velocity of runoff is sufficiently high, an engineered structure such as a rock chute or block chute is required to control the grade and head-cutting of natural or artificial channels, thereby preventing the advancement or formation of gullies. As with certain other practices, installation of these structures can result in a directed discharge of waterborne pollutants into receiving streams. For this reason, their construction should be accompanied by installation of appropriately designed filter strips which can trap sediment, nutrients, and pesticides upstream from the structure. These filter strips must be sized to allow for conformance with regulations pertaining to application setback for specific pesticides used in their vicinity (NRCS Code 410).

Grassed Waterway – A constructed shallow channel that is shaped and vegetated to provide for stable conveyance or runoff (NRCS Code 412).

Heavy Use Area Protection –To stabilize facility areas frequently and intensely used by people, animals, or vehicles (NRCS Code 561).

No-Till – Assistance with the expenses of no-till practices, such as chaff spreader on combine, no-till coulter, row cleaners, split nitrogen applications, variable rate phosphorus, potassium and lime application (NRCS Code 329).

Riparian Buffer – Establishment or management of grasses and forbs, tolerant of intermittent flooding or saturated soils, in the transitional zone between terrestrial and aquatic habitats (NRCD Code 390).

Roof Runoff Structure – Structures that collect, control, and transport precipitation from roofs (NRCS Code 558).

Spring Development – Collection of water from springs or seeps to provide water for a conservation need. Used to improve the quantity and/or quality of water for livestock, wildlife or other agricultural uses (NRCS Code 574).

Watering Facility - A permanent or portable device to provide an adequate amount and quality of drinking water for livestock and/or wildlife. This practice is used to provide access to drinking water for livestock and/or wildlife in order to meet daily water requirements and improve animal distribution (NRCS Code 614).

Pasture and Hayland Planting - Establishing adapted and/or compatible species, varieties, or cultivars of herbaceous species suitable for pasture, hay, or biomass production. (NRCS Code 512)

About Your Farm Operation

1. Please select the option that best describes who generally makes management decisions for your operation.
   - O Me alone or with my spouse - 73.6%
   - O Me with my tenant - 10.3%
   - O Me with my family partners (siblings, parents, children) - 11.5%
   - O Me and my business partners - 10.3%
   - O Me with the landowner - 1.1%
   - O Someone else makes the decisions for the operation - 1.1%
   - O Other - 2.3%
2. Please estimate the total tillable acreage (owned and/or rented) of your farming operation this year. Min=0; Max=2480; Ave 113 acres
3. This year, how many acres of the following do you manage? If none, please enter a zero.

Corn	Min=0; Max=750; Ave=33 (acres)
Soybeans	Min=0; Max=1920; Ave=49 (acres)
Small Grains	Min=0; Max=57; Ave=2 (acres)
Pasture	Min=0; Max=700; Ave=27 (acres)
Forest / Woodland	Min=0; Max=2390; Ave=60 (acres)

4. How many of the following animals are part of your farming operation? In none, please enter a zero.
   - Min=0; Max=200; Ave=3: Dairy cattle, including heifers and young stock
   - Min=0; Max=550; Ave=15: Beef cattle, including young stock
   - Min=0; Max=1200; Ave=14: Hogs
   - Min=0; Max=30; Ave=1: Poultry
   - ____________Other (specify here):____
5. Does the property you manage touch a stream, river, lake, or wetland?
   - O Yes - 70.4%
   - O No - 29.6%

About You

1. What is your gender?
   - O Male - 76.4%
   - O Female - 23.6%
2. What is your age: Min=28; Max=91; Ave=59
3. What is the highest grade in school you have completed?
   - O Some formal schooling - 2.3%
   - O 2 year college degree - 9.2%
   - O High school diploma/GED - 33.3%
   - O 4 year college degree - 17.2%
   - O Some college - 18.4%
   - O Post-graduate degree - 19.5%
4. How long have you lived at your current residence (years)? Min=1 year; Max=78, Ave=28 years
5. Which of the following best describes where you live?
   - O In a town, village, or city - 6.7%
   - O In an isolated, rural, non-farm residence - 24.4%
   - O Rural subdivision or development - 2.2%
   - O On a farm - 66.7%
6. Where are you likely to seek information about soil and water conservation issues? (Check all that apply)
   - O Newsletters/brochures/factsheet - 61.8%
   - O Conversations with others - 58.4%
   - O Internet - 42.7%
   - O Trade publications/magazines - 23.6%
   - O Radio - 7.9%
   - O None of the above - 12.4%
   - O Workshops/demonstrations/meetings - 24.7%

Indian Kentuck Watershed

Your Opinions

Please indicate your level of agreement or disagreement with the statements below.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. Using recommended management practices on farms improves water quality. **Responses: 87**	1.1	0	9.2	60.9	28.7
2. It is my person responsibility to help protect water quality. **86**	2.3	0	5.8	68.6	23.3
3. It is important to protect water quality even if it slows economic development. **86**	1.2	2.3	15.1	64	17.4
4. My acres have an impact on water quality. **85**	2.4	7.1	22.4	55.3	12.9
5. I would be willing to pay more to improve water quality (for example: through local taxes or fees) **86**	7	27.9	41.9	19.8	3.5
6. I would be willing to change management practices to improve water quality. **86**	2.3	3.5	27.9	59.3	7
7. The quality of life in my community depends on good water quality in local streams, rivers and lakes. **87**	1.1	2.3	21.8	57.5	17.2

Water Impairments

Below is a list of water pollutants and conditions that are generally present in water bodies to some extent. The pollutants and conditions become a problem when present in excessive amounts. In your opinion, how much of a problem are the following water impairments in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Sedimentation (dirt and soil) in the water **Responses: 77**	20.7	25.3	26.4	16.1	11.5
2. Bacteria and viruses in the water (such as E. Coli / coliform) **66**	23	14.9	23	14.9	24.1
3. Trash or debris in the water **79**	25.6	22.1	31.4	12.8	8.1
4. Cloudiness of the water **76**	31	33.3	16.1	6.9	12.6
5. Algae in the water **74**	22.1	38.4	14	11.6	14
6. Invasive aquatic plants and animals **71**	30.2	23.3	22.1	7	17.4
7. Pesticides **71**	25.3	14.9	23	9.2	27.6

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Sources of Water Pollution

The items listed below are sources of water quality pollution across the country. In your opinion, how much of a problem are the following sources in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Soil erosion from farm fields **Responses: 82**	15.1	29.1	43	8.1	4.7
2. Soil erosion from shorelines and/or stream banks **78**	24.4	19.8	37.2	9.3	9.3
3. Improper disposal of household wastes (chemicals, batteries, florescent light bulbs, etc.) **74**	25.6	24.4	26.7	9.3	14
4. Improper disposal of used motor oil and/or antifreeze **71**	31	38.7	16.1	5.7	18.4
5. Improperly maintained septic systems **71**	26.7	14	29.1	12.8	17.4
6. Manure from farm animals **75**	31	26.4	18.4	10.3	13.8
7. Littering/illegal dumping of trash **83**	19.5	24.1	35.6	16.1	4.6
8. Excessive use of fertilizers for crop production **70**	29.9	25.3	20.7	4.6	19.5
9. Pasture grazing **78**	47.1	27.6	12.6	2.3	10.3
10. Inappropriate waste disposal **69**	32.2	18.4	23	5.7	20.7
11. Dredging of streams **71**	55.8	16.3	5.8	4.7	17.4
12. Streambank or shoreline modification/destabilization **73**	40.2	17.2	21.8	4.6	16.1
13. Contaminated sediments **64**	34.5	18.4	18.4	2.3	26.4

Consequences of Poor Water Quality

Poor water quality can lead to a variety of consequences for communities. In your opinion, how much of a problem are the following issues in your area?

	Not a Problem	Slight Problem	Moderate Problem	Severe Problem	Don't Know
1. Loss of desirable fish species **Responses: 68**	29.9	27.6	13.8	6.9	21.8
2. Reduced opportunities of water recreation **76**	33.36	25.3	24.1	4.6	12.6
3. Reduced quality of water recreation activities **76**	33.3	28.7	17.2	8	12.6
4. Excessive aquatic plants or algae **73**	27.6	18.4	24.1	13.8	16.1

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Practices to Improve Water Quality

Please indicate which statement most accurately describes your level of experience with each practice listed below.

	Not relevant for my property	Never heard of it	Somewhat familiar with it	Know how to use it; not using it	Currently use it
1. Use no-till to reduce erosion **Responses: 53**	38.4	0	5.8	10.5	45.3
2. Establish permanent vegetation on retired agricultural land to reduce erosion **64**	25.6	1.2	7	11.6	54.7
3. Follow an approved grazing plan to maintain grass quality and reduce erosion **44**	48.8	1.2	9.3	15.1	25.6
4. Plant trees to reduce erosion **57**	34.5	0	10.3	26.4	28.7
5. Use a pond to provide water for livestock **35**	59.3	0	0	14	26.7
6. Use a well to provide water for livestock **24**	72.1	0	3.5	14	10.5
7. Improve springs and seeps to provide water for livestock **33**	62.1	1.1	4.6	17.2	14.9
8. Use fences to exclude livestock from riparian buffer **33**	62.1	4.6	9.2	12.6	11.5
9. Plant vegetation in critical erosion areas **57**	33.7	1.2	8.1	12.8	44.2
10. Plant forested riparian buffer **49**	43.7	13.8	9.2	18.4	14.9
11. Plant herbaceous riparian buffer **48**	44.8	16.1	5.7	20.7	12.6
12. Manage runoff from roofs **60**	31	1.1	11.5	14.9	41.4

Specific Constraints of Practices

Cover Crops: Planting cover crops for erosion protection and soil improvement

1. How familiar are you with this practice? **Responses: 87**

   O Not relevant - 25.3%

   O Never heard of it - 1.1%

   O Somewhat familiar with it - 10.3%

   O Know how to use it; not using it - 18.4%

   O Currently use it - 44.8%

2. If the practice is not relevant, please explain why.

3. Are you willing to try this practice? O Yes or already do - 67.2% O Maybe - 19.7% O No - 13.1% **61**

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
4. Don't know how to do it **60**	61.4	4.3	17.1	2.9	14.3
5. Time required **59**	42	13	20.3	10.1	14.5
6. Cost **61**	30	12.9	20	24.3	12.9
7. The features of my property make it difficult **59**	42.9	12.9	12.9	15.7	15.7
8. Insufficient proof of water quality benefit **54**	52.2	8.7	14.5	2.9	21.7
9. Desire to keep things the way they are **60**	53.6	5.8	11.6	15.9	13
10. Hard to use with my farming system **61**	53.5	9.9	12.7	9.9	14.1
11. Lack of equipment **62**	37.1	15.7	14.3	21.4	11.4

Pasture or Hay Crop: A crop of hay or pasture used to improve and protect soil.

12. How familiar are you with this practice? **Responses: 87**

O Not relevant - 20.7%

O Never heard of it - 1.1%

O Somewhat familiar with it - 11.5%

O Know how to use it; not using it - 14.9%

O Currently use it - 51.7%

13. If the practice is not relevant, please explain why.

14. Are you willing to try this practice? O Yes or already do - 69.7% O Maybe - 7.6% O No - 22.7% **66**

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
15. Don't know how to do it **64**	66.2	6.8	13.5	0	13.5
16. Time required **63**	53.4	12.3	12.3	8.2	13.7
17. Cost **64**	44.6	6.8	17.6	17.6	13.5
18. The features of my property make it difficult **66**	55.4	6.8	14.9	12.2	10.8
19. Insufficient proof of water quality benefit **58**	57.5	9.6	11	1.4	20.5
20. Desire to keep things the way they are **65**	54.1	6.8	10.8	16.2	12.2
21. Hard to use with my farming system **61**	52.7	9.5	6.8	13.5	17.6
22. Lack of equipment **65**	40.5	9.5	13.5	24.3	12.2

Critical Area Fencing: Fencing that excludes animals from critical areas such as woods, wetlands, drainage, ditches, streams, lakes, and ponds.

23. How familiar are you with this practice? **Responses: 88**

O Not relevant - 37.5%

O Never heard of it - 2.3%

O Somewhat familiar with it - 9.1%

O Know how to use it; not using it - 25%

O Currently use it - 26.1%

24. If the practice is not relevant, please explain why.

25. Are you willing to try this practice? O Yes or already do - 49.2% O Maybe - 15.3% O No - 35.6% **59**

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
26. Don't know how to do it **57**	59.4	7.2	13	2.9	17.4
27. Time required **58**	42.3	5.6	15.5	18.3	18.3
28. Cost **58**	35.7	2.9	12.9	31.4	17.1
29. The features of my property make it difficult **60**	47.1	8.6	12.9	17.1	14.3
30. Insufficient proof of water quality benefit **57**	60	4.3	11.4	5.7	18.6
31. Desire to keep things the way they are **60**	54.3	7.1	8.6	15.7	14.3
32. Hard to use with my farming system **58**	45.7	14.3	8.6	14.3	17.1
33. Lack of equipment **61**	43.7	12.7	11.3	18.3	14.1

Watering Trough or Tank: A trough or tank used to provide water for livestock.

34. How familiar are you with this practice? **Responses: 83**

- O Not relevant - 49.4%
- O Never heard of it - 2.4%
- O Somewhat familiar with it - 8.4%
- O Know how to use it; not using it - 12%
- O Currently use it - 27.7%

35. If the practice is not relevant, please explain why.

36. Are you willing to try this practice? O Yes or already do - 39.1% O Maybe - 15.2% O No - 45.7% **46**

How much do the following factors limit your ability to implement this practice?

	Not at all	A little	Some	A lot	Don't Know
37. Don't know how to do it **48**	68.3	0	8.3	3.3	20
38. Time required **49**	58.3	3.3	11.7	8.3	18.3
39. Cost **49**	49.2	3.4	8.5	22	16.9
40. The features of my property make it difficult **50**	56.7	0	13.3	13.3	16.7
41. Insufficient proof of water quality benefit **47**	63.8	3.4	12.1	1.7	19
42. Desire to keep things the way they are **48**	53.3	3.3	6.7	16.7	20
43. Hard to use with my farming system **47**	55	3.3	8.3	11.7	21.7
44. Lack of equipment **49**	55	5	6.7	15	18.3

Making Decisions for my Property

In general, how much does each issue limit your ability to change your management practices?

	Not at all	A little	Some	A lot	Don't Know
1. Personal out-of-pocket expense **74**	11	4.9	28	46.3	9.8
2. Lack of government funds for cost-share **66**	20.7	11	22	26.8	19.5
3. Not having access to the equipment that I need **68**	16.5	8.9	31.6	29.1	13.9
4. Lack of available information about a practice **71**	33.3	24.7	13.6	16	12.3
5. No one else I know is implementing the practice **61**	47.4	14.1	7.7	9	21.8
6. Concerns about reduced yields **65**	50.6	13.6	8.6	7.4	19.8
7. Approval of my neighbors **68**	66.7	6.2	7.4	3.7	16
8. Don't want to participate in government programs **67**	50.6	13.6	8.6	14.8	17.3
9. Requirements or restrictions of government programs **65**	34.6	13.6	14.8	17.3	19.8
10. Possible interference with my flexibility to change land use practices as conditions warrant **64**	31.2	15	18.8	15	20
11. Environmental damage caused by practice **60**	49.4	13.9	10.1	2.5	24.1
12. I do not own the property **68**	79.2	2.6	3.9	2.6	11.7
13. Not being able to see a demonstration of the practice before I decide **63**	43.6	19.2	14.1	3.8	19.2

Indian Kentuck Watershed

Information Sources

People get information about water quality from a number of different sources. To what extent do you trust those listed below as a source of information about soil and water?

	Not at all	Slightly	Moderately	Very much	Not familiar
1. Soil & Water Conservation District (SWCD) **81**	1.2	3.6	33.7	59	2.4
2. Natural Resources Conservation Service (NRCS) **79**	1.2	6	30.1	57.8	4.8
3. University Extension **74**	2.4	15.7	28.9	42.2	10.8
4. State agricultural agency **70**	7.4	12.3	34.6	32.1	13.6
5. State environmental agency **70**	11	22	28	24.4	14.6
6. Environmental groups **72**	18.3	35.4	25.6	8.5	12.2
7. Farm Bureau **73**	11	20.7	31.7	25.6	11
8. Fertilizer representatives **73**	26.5	28.9	26.5	6	12
9. Crop consultants **72**	16.9	25.3	33.7	10.8	13.3
10. Other landowners/friends **79**	3.6	22.9	36.1	32.5	4.8
11. State natural resources agency **75**	7.2	15.7	37.3	30.1	9.6
12. County Health Department **75**	18.1	20.5	38.6	13.3	9.6
13. Land trust **55**	16	23.5	23.5	4.9	32.1
14. Farm Service Agency **74**	8.5	17.1	34.1	30.5	9.8

Septic Systems

1. Do you have a septic system? - **Responses: 86**

   O No - 10.5%
   O Don't Know - 0%
   O Yes - 89.5%

2. Within the last five years, have you had any of the following problems? (Check all that apply) - **Responses: 82**

   O Slow Drains - 6.1%
   O Sewage backup in house - 1.2%
   O Bad smells near tank or drain field - 4.9%
   O Sewage on the surface 2.4%
   O Sewage flowing to ditch - 1.2%
   O Frozen septic - 0%
   O None - 89%
   O Don't know - 1.2%

3. How would you know if your septic system was NOT working properly? (Check all that apply) - **Responses: 76**

   O Slow Drains - 72.4%
   O Sewage backup in house - 61.8%
   O Bad smells - 69.7%
   O Toilet backs up - 63.2%
   O Wet spots in lawn - 72.4%
   O Pumping tank monthly or more - 34.2%
   O Straight pipe to ditch - 21.1%
   O Frozen septic - 21.1%
   O None - 2.6%
   O Don't know - 2.6%

Thank you for your time and assistance!

Please return your completed survey in the postage-paid envelope provided. Please use the space below for any additional comments about this survey or water resource issues in your community.

For more information about the Indian Kentuck Watershed Project, please contact

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Survey #:____________