PROJECT TITLE: **A BASELINE EVALUATION NECESSARY TO MONITOR THE LONG-TERM EFFECTS OF LAND USE CHANGES PLANNED FOR TWO ECOLOGICALLY SENSITIVE WATERSHEDS IN NORTHEASTERN ARKANSAS, THE ELEVEN POINT AND CURRENT RIVERS**

PROJECT SUMMARY: Dramatic changes in land use are occurring in northeastern Arkansas as poultry production expands eastward across the Ozark ecoregion. This change in land use is anticipated to result in water quality declines in a very aesthetically and ecologically significant area. An ecological study is proposed for the Eleven Point and Current River systems. The goal of this research is to provide baseline water-quality and biological data that will facilitate later comparisons of ecological conditions before and after land use changes. Ecological conditions will change more dramatically and rapidly in small streams; thus, 24 wadeable stream sites are targeted for sampling. The primary objective of this study will be to use biological metrics to compare the condition of periphyton, macroinvertebrate, and fish assemblages to selected nutrient and sediment related water-quality and habitat variables prior to dramatic changes in land use (and land use intensity) that are expected over time.

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PROJECT PARTNERS: Billy Justus, Aquatic Research Biologist, USGS, Lower Mississippi-Gulf Water Science Center, Little Rock, AR; Jeff Quinn, Fishery Biologist, Arkansas Game & Fish Commission, Mayflower, AR

ESTIMATED PROJECT COST:

SWG amount requested - $102,989
Match amount provided - $57,685
Total project amount - $160,674

PROJECT STATEMENT: In 2014 and 2015, Arkansas ranked third in the nation in poultry production and a rapid poultry expansion is occurring eastward across the Ozark ecoregion in northern Arkansas. Associated changes in land use are anticipated to result in water quality declines in this very ecologically significant area. Poultry processing facilities have been upgraded or recently constructed in northeastern Arkansas, and an estimated 700-800 poultry houses are planned for construction in the following watersheds: Spring River (11010010), Eleven Point River (11010011), Strawberry River (11010012) and Current River (11010008). Because of their proximity to the Pocahontas Processing facility, most of the new poultry houses that are planned likely will be within the Eleven Point and Current River basins. Many stream miles of the Eleven Point and Current Rivers are designated as Outstanding Resource Waters (e.g. Ecologically Sensitive Waters and Extraordinary Resource Waters), and this study addressed those two basins.

The karst geology of the Salem Physiographic Province of the eastern Ozark Highland ecoregion results in a strong spring influence, and in the typical historic setting, Ozark streams are known for their pristine nature. Compared to nutrient concentrations in wadeable streams across the United States, Herlihy and Sifneos (2008) determined that TP and TN concentrations for reference streams in the nutrient ecoregion containing the Ozarks were typically lowest and second lowest (respectively) of the 11 nutrient ecoregions evaluated. Based on Arkansas Natural Resource Commission records for 2015, poultry houses in Arkansas produced an average of 154.2 tons of litter/house. Annual litter production for the expansion could range from 108,000 to 123,000 tons over the short term (with construction of more poultry houses being possible over the long term). The availability of litter for fertilizer and associated increases cattle feeding capacity, these changes in land use will result in increased nutrient and sediment runoff into an ecologically significant area.

Associated with a strong spring influence, the Eleven Point and Current Rivers also have cooler water temperatures than many other Ozark streams. Related to the cool temperatures, the two rivers support some of the highest levels of aquatic biodiversity in the state. In addition to being inhabited by numerous federally threatened or endangered species (e.g. Ozark Hellbenders, Pink Mucket) numerous other state and federally recognized Species of Greatest Conservation Need (SGCN) are found there. Unfortunately, the current status of many of the SGCNs is unknown or incomplete. Arkansas ranks fifth in the nation in fish biodiversity and sixth in crayfish diversity; however, both rivers contain large areas with data gaps for fishes and crayfishes. Relatedly, relatively little is known about the status of aquatic biological communities in the Current and Eleven Point basins.

In addition to their ecological significance, the two watersheds are aesthetically and economically significant. Both are not only important sport fishery resources, but some segments could be classified as having world class smallmouth bass fisheries, with other segments having excellent walleye and trout fisheries. Multiple canoe outfitters operate on segments of the Eleven Point and Current Rivers.

Fish and nutrient water quality samples have been collected from a few sites in the Eleven Point and Current basins in recent years by the Arkansas Department of Environmental Quality (ADEQ); however, the biological and chemical data necessary to do a thorough baseline

ecological evaluation for these sensitive watersheds is far from complete. Given their aesthetic, economic, and ecological significance, an ecological study is needed that will establish a baseline data set to facilitate long-term ecological evaluations.

PURPOSE AND OBJECTIVES: The purpose of this project will be to provide baseline water-quality and biological data to facilitate later comparisons for ecological characteristics measured before and after land use changes in these northeast Arkansas watersheds. Ecological conditions will change more dramatically and rapidly in small streams; thus, 24 wadeable stream sites are targeted for sampling. The primary objective of this study will be to use biological metrics to compare the condition of algal, macroinvertebrate, and fish assemblages to selected nutrient and sediment related water-quality and habitat variables prior to changes in land use that are likely to occur over time.

LOCATION: Field reconnaissance will be conducted at streams with wadeable stream reaches within the two watersheds to select 24 sampling sites. Geographic information system analysis will be used to select sites along a forest/pasture gradient in each watershed.

RESEARCH APPROACH: Water-quality samples will be collected following USGS protocols. Water will be collected during base-flow conditions on three occasions—in each of the two months prior to biological samples and at the time of biological sampling. Water samples will be grabbed from three locations in the stream cross section. Water for dissolved nutrients will be filtered on-site with a 0.45-µm filter, and unfiltered water will be collected for total nutrients. Samples for TSS and turbidity also will be collected. All samples will be analyzed at the Ecotoxicology Research Facility (ERF), an EPA-certified laboratory. At the time of site reconnaissance and on all sampling occasions, conductivity, pH, water temperature, and dissolved oxygen will be measured using a calibrated multi-probe field meter.

All sampling will be conducted in a preselected reach of a length approximately equivalent to 20 times the mean wetted channel under baseflow conditions in late summer. Periphyton, macroinvertebrate, and fish samples will be collected and processed with USGS methods used previously for assessments conducted at approximately 50 Ozark streams. Fish will be collected using electrofishing (backpack or barge electrofishing units) as the primary sampling method with seining as a supplemental method. Except for small fish that are difficult to identify without magnification or are otherwise unknown, fish will be identified in the field and released at the point of capture. A quantitative periphyton subsample will be collected from five cobbles at each of the five riffle locations (i.e. 25 subsamples will be composited). In addition to a sample for species identification, one aliquot of the periphyton sample will be filtered for chlorophyll *a* analysis (at ERF). A disturbance-removal process will be used to collect macroinvertebrate samples from coarse-grained riffle substrates adjacent to locations where periphyton samples are collected. Five discrete macroinvertebrate subsamples collected with a Slack sampler from riffles located throughout the reach will be combined to form that sample. Taxonomy for the periphyton and macroinvertebrate samples will be conducted at the ERF laboratory, with a subset of samples sent to contract laboratories for quality assurance purposes.

Habitat measurements made in conjunction with biological sampling, will provide evidence regarding sedimentation and associated compromised substrate quality. Habitat characteristics will be recorded at 11 equidistant transects. At the same time of habitat measurements, macroalgae cover will be visually estimated at each of 5-1 m^2 quadrats (two edges of water and three locations spaced at equal intervals across each of the 11 transects).

EXPECTED RESULTS AND BENEFITS: As human population increases, animal production will continue to expand into remote areas where many reference quality streams are located. Stream nutrient conditions change over extended periods and the ecological consequences, although sometimes dire, are often complex and difficult to thoroughly document. Baseline ecological data are a necessary component that must be available before the public can be adequately informed and important ecological resources receive due consideration and adequate protection. Consequently, the increased capability for long-term monitoring is anticipated to be perhaps the greatest benefit of this project. That being said, USGS has also used these same sampling methods to document ecological conditions at approximately 50 wadeable streams throughout the Ozarks ecoregion with different degrees of poultry production; hence, the data collected for this study will not only facilitate comparisons over time, but also across space (the entire Ozark ecoregion). Graduate students working on this project will be a vital part of field collections and laboratory analyses, and a Master of Science thesis and peer-reviewed publications are planned.

Table 1. Budget (Eleven Point and Current Rivers)		
	Request	Match
Salaries & Benefits		
PI Salary (Jennifer Bouldin)		$ 4,402
Graduate Student	$ 36,000	
AGFC biologist		$ 2,160
Fringe (PI)		$ 1,019
Travel		$ 7,200
Equipment (vehicles, shocker maintenance, WQ monitors)	$ 1,100	
Supplies (preservative, lab/sampling supplies)		$ 700
Sample analysis		$ 10,800
Fuel and shipping		
Subtotal A-State	**$ 37,100**	**$ 26,281**
Subaward - USGS	$ 62,179	
Project Cost	**$ 99,279**	
IDC (10%, 29.73% match)	$ 3,710	$ 11,030
IDC on Match amount		$ 10,441
IDC on Subaward (39.73% of first $25,000)		$ 9,933
Total Request/Match	**$ 102,989**	**$ 57,685**
*housing during travel (48 nights for 6 people) @$125/night		

QUALIFICATIONS:

Dr. Jennifer Bouldin received her PhD in Environmental Sciences from Arkansas State University and is a Professor of Environmental Biology at A-State. She has been the Director of the Ecotoxicology Research Facility (ERF) since 2006. She maintains USEPA certification and requires an annual inservice for Good Laboratory Practice for all researchers, technicians and students at the ERF. She and her students have published on water, soil and sediment toxicology, and long-term watershed studies including the Spring, Strawberry, Cache, Buffalo, and L'Anguille rivers. The ERF is a multidisciplinary research facility utilizing whole organism bioassays, organism collection and identification, and analytical analyses with the GCMS, AA, and Skalar SAN nutrient analyzer.

Billy Justus has a Bachelor of Science in wildlife management (1987) and a Master of Science in biology (1990), both of which he acquired from A-State. From 1989 until 1995, he was employed as an aquatic biologist with the Mississippi Department of Environmental Quality but has worked at USGS since 1995. As a research aquatic biologist for USGS, most of Billy's projects are multidisciplinary ecological studies that investigate interactions between aquatic biota and multiple types of environmental stressors. Some of his most recent publications have identified biological thresholds for various constituents (i.e. dissolved oxygen and nutrients). He has been an electrofishing field trainer for USGS and has led fish sampling crews and served as field taxonomist in 18 states.

Jeff Quinn is a Stream Fisheries Biologist with the Arkansas Game and Fish Commission. He received his M.S. degree from the University of Arkansas, and has been employed with AGFC since 1998. He has published 13 peer-reviewed papers in scientific journals and books, and is an American Fisheries Society Certified Fisheries Professional.