Report for 2004OK30B: Evaluation of Chemical and Biological Loading to the Blue River

- Conference Proceedings:
  - Stoecker, A.L. R. Alviar, and T. Ancev, Use of GIS Simulation and Mathematical Programming to Determine Economically Efficient Pollution Abatement in a Watershed, Inv. Paper, International Seminar on Agricultural and Natural Resource Economics, Medellin, Columbia, Dec. 2004.
- Other Publications:
  - Prado, Baltazar. 2005 An Economic Examination of Potential Electricity and Fertilizer Production in the Eucha-Spavinaw Watershed M.S. Creative Component, Dept. of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma, 44 pp.
  - Sadhu, Joy. 2005 Evaluation of Economic Gains to Broiler Producers by Modulating Ventilation and Using Alum for Ammonia Control, M.S. Thesis, Edmond Low Library, Oklahoma State University, 84 pp.

Report Follows

Annual Progress Report on Evaluation of Chemical and Biological Loading to Blue River.

June 15, 2005

Submitted by Dr. Guy W. Sewell
Professor Environmental Health Sciences
East Central University
Ada, OK

Problem and Research Objectives:

Oklahoma's abundant water resources are adequate to provide for the current needs of the State's citizens, but for future use, these resources need to be managed properly and protected from degradation. A baseline assessment of natural or background biological loading is needed to evaluate water quality standards, and to serve as a baseline for the detection of, and for evaluating any degradation of water quality.

This project will addresses one of the Priority Water Research Topics for 2004 as outlined in the call for proposals (#4),

> Quantitative relationship between runoff from wildlife habitats and in-stream bacterial concentration to distinguish between risks from human and natural contamination in setting water quality bacteriological standards.

and provide data for 2 other priority topics (#2, #5).

> Development of a phosphorus index that quantitatively relates field application of phosphorus fertilizer (e.g., chicken litter) to phosphorus loads in downstream receiving streams and lakes.

> Quantification of effectiveness of riparian zones to remove nutrients, sediment, and pathogens from runoff.

Blue River represents both a water and natural resource to Oklahoma (See Figure 1). Segments of the Blue River were listed in 1998 as impaired due to nutrients and noxious aquatic plants. While the river was not listed as impaired in the Oklahoma 2002 assessment report for these pollutants the need to assess and protect this resource remains.

ECU will measure and evaluate total coliforms, E. coli, phosphorus, ammonia, nitrate and other parameters along the course of Blue River, monthly, over a one-year period. Four Oklahoma Department of Wildlife Conservation designated public access points will be evaluated, upstream and down stream, plus 7 additional locations (See Figure 2). ODWC will characterize land use patterns along the river course and evaluate daily usage in the public access points. The parties will share project results and information.

The major objectives of the project will be as follows:

- Define bacterial (total coliform and E coli) load at sample locations
- Relate loading to upstream land use
- Evaluate bacterial loading in relationship to other water quality parameters
- Evaluate bacterial loading in relationship to human usage
- Define river discharge@time for sample locations
- Evaluate bacterial survival

Methodology:

A. Determination of total coliforms and *E coli* in water, and sample collection procedures: Total coliform and E coli quantification will be through the use of Hach's m-ColiBlue24® Membrane Filtration method (EPA Approved* Method 10029) for the simultaneous detection of total coliforms and *E. coli.*

B. Nitrate: Total nitrate will be determined by means of the Hach Water Analysis Handbook Method 8192, the Cadmium Reduction Digestion Method (0.01 to 0.5 mg/L range)

C. Ammonium: Total ammonium nitrogen will be determined by means of the Hach Water Analysis Handbook Salicylate, the PhosVer 3, Acid persulfate Digestion Method (0.05 to 1.5 mg/L range)

D. Phosphorus: Total phosphorus will be determined by means of the Hach Water Analysis Handbook Method 8190, the PhosVer 3, Acid persulfate Digestion Method (0.02 to 3.5 mg/L range)

F. Stream Velocity, Discharge and Cross Sectional Area Determinations:
Data and Calculations for average stream velocity and discharge will be done according to methods outlined in Fetter (2001), including the direct measurement of velocity with current meters, use of the Manning Equation, and determination of cross sectional area. Extensive characterization of sample site for elevation, gauging reference points, velocity distributions and channel geometry will be conducted at low flow periods (July 2004).

G. Land-use Determinations and Human Impact: ODWC personnel will carry out land-use characterizations, by direct visualization linked to GPS referencing, and through the use of aerial photographs. ODWC personnel will also quantify fisheries usage (human daily recreational area usage numbers) to allow for human impact studies during times or low and high usage. Trout Stocking Schedule: Blue River 2004 Jan. 5, 8, 14, 22, 28; Feb. 5, 11, 19,25; Mar. 4, 10, 18, 23.

H. Loading and Decay Determinations: Bacterial and chemical loading determinations will be conducted through the use of discharge and concentration data analysis at paired and multiple sampling locations. Bacterial decay determinations will be generated from the same data sets and evaluated for temperature impact (Joyce, 1996, Pope, 2003).

Principal Findings and Significance:

To date biological and chemical assessment of Blue River samples indicates good to marginal water quality with a general trend of decreasing quality as the river travels to the South East. Sections of the river overlaying the Arbuckle-Simpson Aquifer, which appear to have significant base flow discharge from the aquifer, tend to have more desirable characteristics, subject to some fluctuation apparently related to rainfall events and seasonal variations.

E. coli numbers have ranged from non-detect to approximately 100 cfu/ml over the sampling events to date, with average recoveries in the 0-10 cfu/ml, generally following the decrease in water quality from NW to SE.

Evidence of nitrate and phosphate loading to the watershed has been noted but identification of the possible sources and relationships to land use are still under investigation.

The relationships between chemical and biological indicators are being evaluated. Preliminary collaborative efforts with the University of Oklahoma to identify the strains of the recovered environmental isolates seem to suggest an unexpected predominance of strains related to human and animal pathogens. We will continue to evaluate these results.

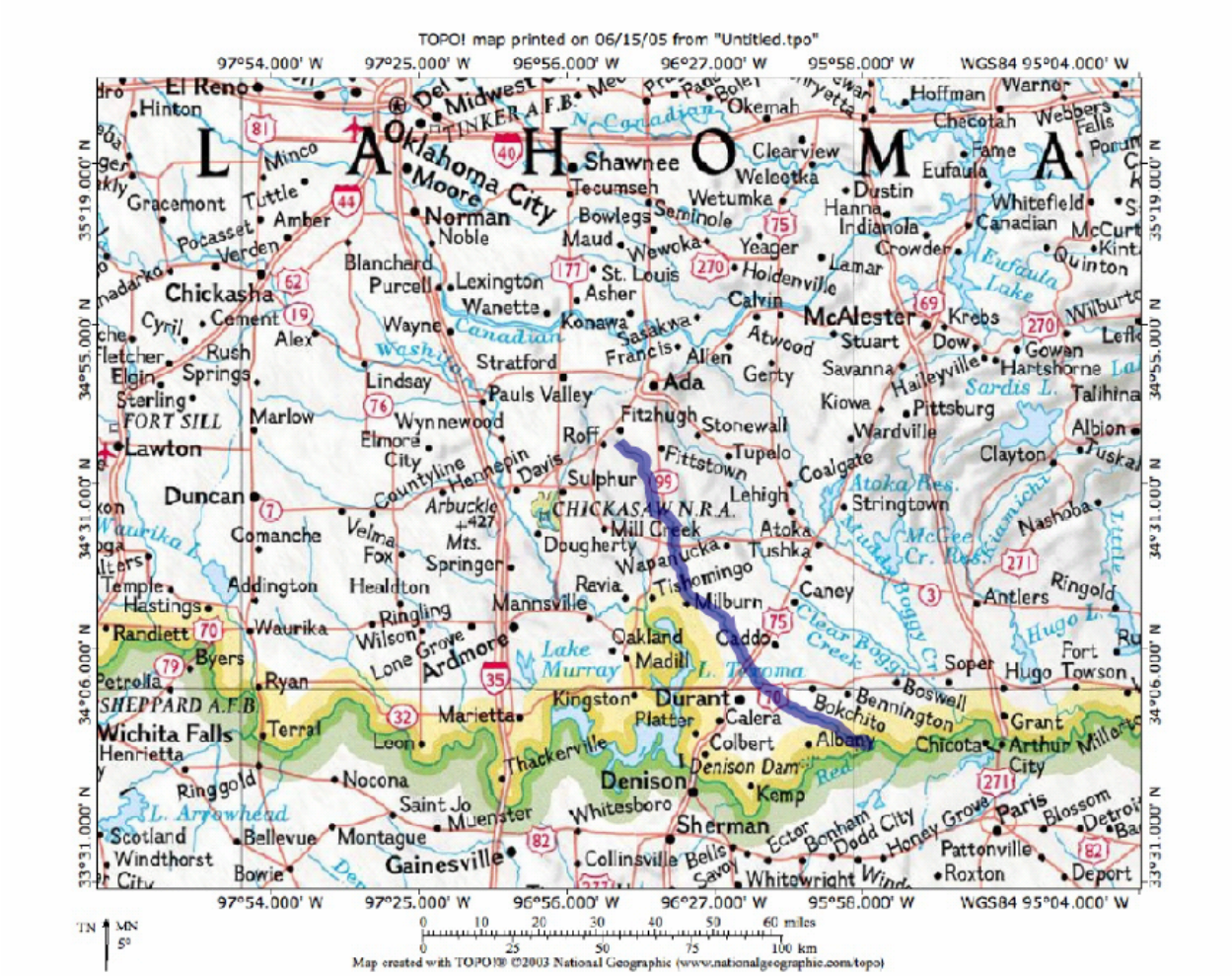

Figure 1. Map showing the location of the Blue River in Oklahoma.

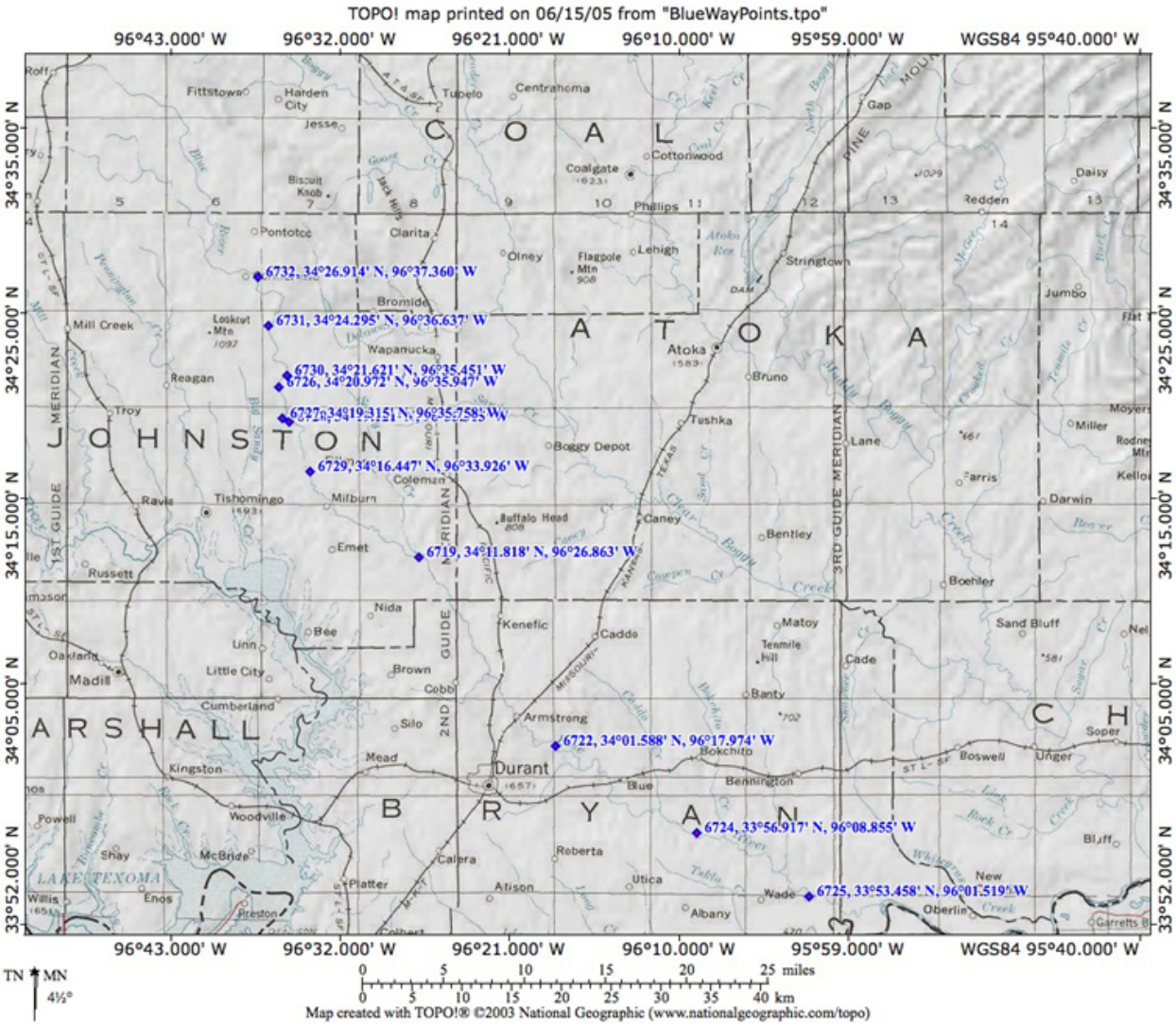

Figure 2. Map showing location of sampling points along the Blue River.