

Project: 3

Agency: Oklahoma Department of Environmental Quality

Title: Lake Tenkiller & Illinois River Project Expansion
Continuation of FY05/06/07 Project 17 — Original project included development of a SWAT model. Expansion of project will provide an update of the SWAT model to include ground water nutrient contributions. Modification of the SWAT model code will allow for the analysis of instream phosphorus concentrations.

SWAT MODEL CODE MODIFICATION

SWAT (Soil and Water Assessment Tool) is a distributed hydrologic model. Distributed hydrologic models allow a basin to be subdivided into many smaller subbasins to incorporate spatial detail. SWAT is a physically-based continuous simulation model that operates on a daily time step. The current SWAT model will be modified to include code allowing the analysis of instream phosphorus concentrations in addition to the models existing capabilities for evaluating nutrient loads. This work will be done through the USDA Agricultural Research Service at the Grassland, Soil and Water Research Laboratory. The modification(s) will be made to SWAT 2005.

UPDATE AND RECALIBRATION OF THE SWAT MODEL FOR THE ILLINOIS RIVER BASIN

Input Data

Because SWAT is a distributed model, data requirements are vast. The management of these requirements is met using an ArcView or ArcGIS interface. Model parameters for each subbasin are calculated from the GIS data. A variety of available GIS data will be used in SWAT. Below is a list of GIS and other related data that will be utilized in the updated SWAT model.

- Recently available land cover will be evaluated to determine if it is more appropriate than the 2001 land cover used in the previous study
- Updated poultry house locations with active/inactive status
- Litter application by sub-basin
- New 10 m USGS DEM
- 1:250,000 NRCS STATSGO soils data
- Tabular weather data from the NOAA COOP (National Oceanic and Atmospheric Administration Cooperative Observer Program) network
- USGS gage data
- Updated point source data (provided by ODEQ)
- Groundwater Inflow (Phosphorus Contribution)
- Updated livestock numbers
- Cattle grazing
- Slope by land cover correction
- Updated soil test phosphorus data
- Soil test phosphorus estimates by land use and by sub-basin

ODEQ will provide monthly estimates of mineral and organic phosphorus, mineral and organic nitrogen, and flow for the period 1990 to current for all permitted point sources in the basin. In addition, ODEQ will provide flow from these permitted discharges for the period 1980 to 1989. These estimates will be based on Discharge Monitoring Reports (DMRs) or other available data from the permitted dischargers.

Nutrient Load Estimates

Nutrient loads will be estimated using the USGS software LOADEST2 for 1990 through the most recent available data (i.e. "current") for the following stations:

- a) Flint Creek
- b) Barren Fork
- c) Illinois River near Watts
- d) Illinois River at Chewey
- e) Illinois River at Tahlequah

Loads will be estimated for total phosphorus, dissolved phosphorus, nitrate and organic nitrogen.

SWAT Calibration and Validation

The SWAT model will be calibrated for flow for the period 1990 to current for the multiple stations, and then calibrated for phosphorus and nitrogen loads for the period 1997 to current. Next, the SWAT model will be validated for flow for the period 1980 to 1989 and then validated for phosphorus and nitrogen loads for the period 1990 to 1996.

Nutrient Load and Reduction Scenarios

Nutrient loads will be predicted using the calibrated SWAT model for the following:

- 1) Nutrient contributions from Oklahoma and Arkansas independently for the period 1990 through current (approximated based on sub-basin delineation).
- 2) Nutrient contributions from point and nonpoint sources independently for the period 1990 through current.
- 3) Nutrient contributions from nonpoint sources by category for current conditions
 - a. soil test phosphorus (STP)
 - b. Poultry litter
 - c. Other significant nonpoint sources
- 4) Estimate projected total phosphorus load resulting from 100 percent litter export and a minimum pasture STP level of 65 and 120 lbs/ac. Current pasture STP levels above 65 or 120 lbs/ac will remain at their current level.
- 5) Estimate projected total phosphorus load resulting from poultry litter export of 0, 25, 50, 75 and 100 percent of current.

The following scenarios for nutrient reductions will be evaluated to determine which scenarios or combination of scenarios will meet the following conditions:

1. A monthly geometric mean total phosphorus concentration of 0.037 mg/l in the Illinois River, Barren Fork River and Flint Creek following the Oklahoma Water Resources Board Use Support Assessment Protocols (USAP) protocol.

2. Obtain a 75 percent total phosphorus load reduction to Lake Tenkiller.

The analysis will include the following scenarios:

- 1) Reduction of point source discharges to 1 mg/l or less at the current and future projected effluent design flows (provided by ODEQ).
- 2) Implementation of selected Best Management Practices for nonpoint sources
- 3) Implementation of selected land use conversions

Note that the completion of these analyses is contingent upon proper response and calibration of the in-stream component of SWAT.

Projection Scenarios

- 1) Nutrient contributions to Lake Tenkiller for: a) the period 1990 through current and b) 2010 and 2020 based on current litter application and land cover and projected increases in urban provided by ODEQ.
- 2) Nutrient contribution to Lake Tenkiller based on proposed new point source contributions (provided by ODEQ).
 - a. Osage Basin
 - b. Bentonville

Project Duration

July 1, 2007 to June 15, 2008

Outputs and Schedule

Nutrient loads	January 15, 2008
SWAT Inputs	February 15, 2008
Completed SWAT Calibration and Scenarios	April 15, 2008
Final Report	June 15, 2008

Budget

Total \$110,630

Funding

\$52,206	FY08 Base (Main Program)
<u>\$75,000</u>	FY08 Carryover
\$127,206	Total