Pond Creek Watershed Restoration Plan

Executive Summary

Prepared by:
Jonathan Hagen and Forbes Walker
University of Tennessee Extension –
Biosystems Engineering and Soil Science

2506 EJ Chapman Dr
Knoxville, TN 37996

October 2006

Executive Summary

The Pond Creek Watershed (HUC: TN06010201013) in east Tennessee covers 23,579 acres of which dairy and pasture-based beef operations are the primary land uses. Segments of the primary stream running through the watershed, Pond Creek and two of its major tributaries Greasy Branch and Mud Creek, are listed as only partially supporting their designated uses according to the 2004 Tennessee 303(d) list of impaired waterways prepared by the Tennessee Department of Environment and Conservation (TDEC). Such a classification fulfills the requirements set forth in Section 303(d) of the federal Clean Water Act and the Water Quality Planning and Management regulation at 40 CFR Part 130. Under these same Acts and Sections, states are required to develop plans-of-action to improve and restore waterways to ultimately remove said waterways from the state submitted 303(d) list of impaired waters.

Past and on-going studies conducted by the University of Tennessee show consistently high levels of sediment, nutrients and pathogens throughout Pond Creek. Total suspended solids (TSS) and *Escherichia coli* counts measured at eight sampling sites along the creek have been as high as 577 mg/L and 53,753 cfu/100mL, respectively over the past five years. This water quality sampling has served as the basis for the development of a pathogen Total Maximum Daily Load (TMDL) for Watts Bar Watershed, the reservoir into which Pond Creek deposits. This document composed by TDEC's Water Pollution Control's Watershed Management Section cites the pathogenic bacteria *E. coli* as a high priority, and nitrates and physical substrate/habitat alteration as medium priorities.

To successfully remove Pond Creek from the Tennessee 303(d) list will require a reduction of pathogens of 99% based on the TMDL; a reduction of nitrogen (TN) of 82% based on ecoregion reference streams; and although not presently listed as a priority impairment, a reduction of phosphorus (TP) of 80%. The TMDL identifies pollutant sources such as pasture grazing, livestock in stream and animal feeding operations, all classified as nonpoint pollutant sources. As such, this restoration plan has been developed for the area building upon established partnerships and utilizing a recently developed suite of remote sensing tools to quantify non-point source pollutant loading. This plan identifies current pollutant estimates, suggests best management practices (BMPs), and estimates subsequent post-plan pollution fates and volumes.

The Tennessee Valley Authority (TVA) has developed an Integrated Pollution Source Identification (IPSI) suite of tools, consisting of aerial photographs, a GIS database, a pollutant loading model and a set of analysis tools to help plan and implement watershed restoration efforts. This geographic and numeric database consists of information on local watershed features such as land use/land cover, streambank erosion sites, and livestock operations that are known or suspected to be nonpoint pollution sources. Acreage and land management practices were identified to characterize nonpoint sources of pollution, and the impact which they have.

Due to documented relationships between the movement of bacteria, nutrients and soil particles, nutrient loading and soil loss were used as proxies for pathogen loading for Pond Creek watershed where and when actual pathogen data was not be available. As sediment has been recognized as a major nonpoint source problem for many years, several standards have been established for erosion on agricultural lands, and were applied to determine the fate and volume of TN, TP, TSS, and soil loss. Values for model input parameters were obtained from hydrologic, climate and soil data, land use and land cover data, the Revised Universal Soil Loss Equation (RUSLE), consultation with Natural Resources Conservation Services (NRCS) field staff, water quality sample data and published (EPA, NRCS, Extension Services, peer-reviewed literature) coefficients using critical erosion rates specific to the ecoregion. The coefficients included in this analysis were all screened using certain acceptance criteria, based on the accuracy, precision, local representativeness, and spatial and temporal extent of data sampling. As elevation, soil types and soil textures do not vary considerably within much of the occupied lands of the watershed, the applied values are suitable for the purpose of the present management plan.

Model outputs suggest agriculture (low residue cropland, pasture and livestock) contributes over 70% of annual TN loads, and nearly 80% of TSS loads. Estimated soil loss for all of Pond Creek watershed is 43,253 tons/yr, or 1.83 tons/acre/year, primarily stemming from overgrazed and generally disturbed lands. The bulk of soil loss (79%) from pasture is from heavily overgrazed lands even though this class was not the primary condition of pasture. Despite the relatively low percentage of cropland in the study area (7%), this land class contributed nearly 26% of all soil loss, with 49% of this value stemming from low-residue crops. Residential and commercial sites contributed small amounts of soil loss, but did however contribute significant volumes of TP. Water quality sampling, ground-truthing and a novel bacteria source tracking technique suggest that pathogen sources stem from both livestock and human sources.

These results were used to recommend appropriate BMPs to local landowners for the reduction of erosion and pollution problems from areas and practices identified as critical. The precision of the outputs allowed concentrated evaluation of high-impact areas and land use practices. To estimate the potential benefits of select BMPs, default inputs to the model were amended to reflect the application of recommended management practices. By applying new coefficients to the default model, the two output values are easily comparable. Thus, in addition to the validations listed above, the utility of standard RUSLE values as imports into the model for identification of relative differences justifies the application.

By targeting specific areas and land practices within a watershed, available federal and state cost-sharing funds may be used more efficiently to address known or potential pollution problems to protect and improve water quality. Prioritized and targeted goals and objectives were defined based on the loading model outputs with emphasis on establishing structural BMPs to reduce sediment; stabilizing streambank erosion sites; promoting and installing practices to reduce polluted runoff; and, preventing toxins (hazardous waste, pathogens, and excess nutrients) from entering the waters.

Specific BMPs, and resulting estimated reductions, include, but are not limited to: 1) limiting direct access of livestock to the stream, leading to a decline in pathogens deposited into Pond Creek of 40%; 2) revegetating feedlots and pastures, decreasing soil loss by 23% and TN by 12%; 3) establishing sufficient riparian buffers, decreasing pathogens by 56%, soil loss by 22% and TN by 12%; 4) repairing stream access sites, decreasing pathogen by 40%, soil loss by 19%, and TN by 11%; 5) following a prescribed grazing management plan, decreasing soil loss by 27% and TN by 24%; 6) developing and following site-specific nutrient management; 7) properly maintaining septic systems, decreasing pathogens by nearly 9%; and 8) installing manure holding facilities, decreasing pathogens by 58%. It is anticipated over the proposed 10 year length of this initiative, and assuming a 50% implementation rate, that nitrogen loads will decline approximately 71% and pathogens will decline 94%.

Successful stakeholder participation will, among other things, aid in plan acceptance and improve the probability of success. To this end, a substantial and localized public outreach campaign was prepared to instill within the residents, commercial and industrial businesses, developers, visitors, and public officials a heightened level of awareness of the connection between individual actions and the health of their watershed and water resources. Communication and planning efforts have been tailored to individual audiences to improve soil, crop, livestock, and waste management. Major efforts of this campaign include 1) promoting watershed stewardship via educational tools, materials, programs and assistance; and 2) providing for long-term protection of Pond Creek via continued water quality sampling, tours and workshops of successful BMPs and enforcement and regulations. Proposed education and information activities will be updated and amended as necessary to compliment the objectives of the plan. Additionally, the individual proposed tasks can and should be amended or sacrificed to satisfy the overriding goals and objectives. This type of evaluation will be paramount to reflect, readjust and improve on the performance of all stakeholders and activities involved.

Anticipated costs for this restoration initiative are projected at $1,175,000 (based on 2006 NRCS estimates), with nearly 100% of this budget for on-the-ground BMP implementation and installation. This figure translates to $1.85 per linear foot of stream located in the watershed. To achieve this end, this plan proposes a three-phased approach based on: Phase 1, BMPs that can be initiated immediately, generally requiring minimal cost or planning, such as riparian buffers and fences; Phase 2, BMPs that require significant planning and development, design specifications, and/or additional funding, such as manure holding facilites and stream access sites; and Phase 3, BMPs for which success may depend on the success of a previously implemented BMP, such as many structural BMPs. Marketing activities will begin immediately and continue until project end. Collectively, these phases result in post-restoration loads that approximate those of fully supporting of Pond Creek, indicating that this plan will likely be effective in restoring the waters.

Landscape patterns and processes are the result of historical, diverse and complex interactions between ecological and socio-economical systems. The inherent complexity and expense of watershed monitoring necessitates the development and utility of landscape models, however many computer simulation models overlook the cultural landscape. This restoration initiative aims at developing an effective and integrated land management and monitoring approach for community stakeholders, which include local land owners, communities, authorities and resource managers, as they are required to make coherent, informed decisions regarding land resources and their future. We believe that this approach provides a valuable tool for describing the fate and volume of nonpoint source nutrients and pollutants in small watersheds. Furthermore, we envision the application of our approach to a number of watersheds in southeastern Tennessee, both agriculture and urban, depending on the scale of the study.