ASSESSING EPHEMERAL GULLY EROSION IN THE CHENEY LAKE WATERSHED USING GIS, REGEM AND THE ANNAGNPS MODEL

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Abstract: Ephemeral gully (EG) erosion has been recognized as contributing significantly to sediment losses from agricultural fields, yet most methods for estimating soil erosion do not account for it. The Universal Soil Loss Equation (USLE), or revised and modified versions of it, evaluate soil loss as combined sheet and rill erosion, but do not include erosion due to concentrated flow channels, usually referred to as EGs in its estimates. Watershed models such as AnnAGNPS and SWAT, which are commonly used to evaluate non-point source (NPS) pollution in agricultural watersheds, are based only on combined sheet and rill estimates and do not account for EG erosion. Improved accuracy and adequate calibration of watershed models will likely require that EG erosion be considered as a contributor to sediment and nutrient loading to surface water bodies, especially if conservation practices are to be targeted to treat different NPS sources. We are engaged in a special emphasis, Conservation Effects Assessment Project (CEAP) in the Cheney Lake Watershed of south central Kansas, to study the influence of EG erosion on NPS loading to Cheney Reservoir and to integrate an EG erosion routine into the AnnAGNPS model which can account for this contribution. Preliminary assessment of soil losses in Cheney Lake Watershed suggest that EG erosion may deliver as much as 50 percent of the sediment load to the reservoir. Remote sensing and geographical information systems (GIS) have been used to quantify the occurrence and extent of EGs in the watershed and to extract gully profiles from a digital elevation model, and soil and engineering properties from NASIS soil data. The Revised Ephemeral Gully Erosion Model (REGEM) has been incorporated into AnnAGNPS, and an ArcView script and interface have been developed to populate AnnAGNPS with the necessary inputs to assess EG erosion in the watershed. Additionally, GIS procedures have been used to spatially analyze frequency and location of EGs as a function of soil, slope, tillage, contributing area, and cropping system. Better prediction of gully occurrence will help to locate field management and structure placement in the watershed. Addressing soil erosion from EGs may require a different suite of conservation practices than that required for sheet and rill erosion.

INTRODUCTION

Beta AGNPS/REGEM ARC VIEW INTERFACE: In an effort to capture the land features of ephemeral gully erosion in AnnAGNPS, a user-friendly data entry process is needed. Geographical Information Systems (GIS) have the capability to extract ephemeral gully features with a minimum requirement of user interaction. Currently AnnAGNPS has an AGNPS ArcView interface to aid in some data preparation for AnnAGNPS. Version 3.51, was used to integrate the Avenue Scripts needed for ephemeral gully data extraction. Tabs are added to the drop down menu, AGNPS DATA PREP, for generation of potential gully erosion flow paths, a tool to create and identify the gully mouth data set and create an ephemeral gully data set for export to AnnAGNPS. The only data entry needs from the user is the location of the ephemeral gully mouth. Location of the gully mouth, at this point, is as much an art as a science. The data

set, “Flow Accumulation”, and digital-ortho photography can be used with an “on-screen” process to locate the gully mouth. The flow path characterized by the flow accumulation does not always overlay with the ephemeral gully location indicated on the ortho photo and some judgment is needed for the selection of the gully mouth locations. The Avenue Script routines are written to extract the gully profile, soils, land management and watershed properties from associated data layers. Ephemeral gully data can be appended to an existing annagps.inp file or a new annagnps.inp project can be created. An Arc View project (EG_AGNPS.apr) and User’s Guide have been developed to assist the user in an AnnAGNPS project where ephemeral gully erosion concerns need evaluation. A special “Thank You” is extended to Ming-chieh Lee for his contribution to programming the Avenue Scripts in this project.

Cheney Lake Watershed Conservation Effects Assessment Program (CEAP): The purposes of the national CEAP assessment for cropland are, (1) estimate the environmental benefits for conservation practices applied to cropland, including cropland enrolled in the Conservation Reserve Program (CRP); (2) estimate the benefits of conservation practices currently present on the landscape; (3) estimate the need for conservation practices and the benefits that could be realized if appropriate conservation practices were implemented on all cropland; (4) simulate alternative options for implementing conservation programs on cropland in the future; and (5) incorporate science-based estimates of practice benefits into Natural Resource Conservation Service (NRCS) Performance Reporting System (PRS) to provide annual estimates of benefits for each program. Upon completion of validation and calibration of the AnnAGNPS model including REGEM, the following eight scenarios have been developed to estimate the benefits on conservation treatment within the Cheney Lake watershed:

1. **No Conservation Practices** – All land use is the same as 1997 land use but it is assumed there are no terraces, waterways, or CRP grass. All cropland will be assumed to be conventionally tilled for wheat and milo production. We will assume there is no irrigation.
2. **Ephemeral Gullies Treated** – It is assumed the same land use and all conditions from 1997 except the effect of all ephemeral gullies will be removed from the model.
3. **Conservation Tillage (1) –** It is assumed that all cropland is managed with no-till management practices. All land use, tillage, and conservation practices will be the same as the baseline in 1997.
4. **Conservation Tillage (2)** – It is assumed that all cropland is managed with mulch-till management practices. All land use, tillage, and conservation practices will be the same as the baseline in 1997.
5. **CRP** – It is assumed the same land use and all practices from 1997 except that Conservation Reserve Program grass will be replaced with conventionally tilled wheat and ephemeral gullies will be added in those crop fields.
6. **Native Grass -** The model will be run with the entire watershed planted to native grass.
7. **Split Applications of Atrazine** – It is assumed the same land use and all conditions from 1997 except a split application of Atrazine (half applied in the fall, half applied in early spring) will be included instead of applying the full rate at planting time in the spring.
8. **Irrigation scheduling –** It is assumed the same land use and all conditions from 1997 except that an irrigation trigger will be included when cropland reaches 50% of field capacity soil moisture instead of 70% of field capacity soil moisture.

RESULTS

The EG_AGNPS.apr Beta AGNPS/REGEM Arc View interface has successful extracted the input data for 989 identified ephemeral gullies within the Cheney Lake watershed and populated the AnnAGNPS input editor. As of October 15, 2005, the results of the eight conservation treatment scenarios have not been completed. Selected results will be presented at the conference in April 2006.