CENTRAL REGION INTEGRATED SCIENCE PARTNERSHIP FUNDS
FY 03 Project/Activity Outcome Report
Due: January 9, 2004

Date:	Jan. 6, 2004
Project/Activity Title:	Historical Changes in Water Quality and Land Use in the Cedar River Basin, IA: Implications for Land Management Activities to Increase Denitrification Rates
Account Number:	#83359RF
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Partners and Affiliations:	NA
Total Funding Approved:	80k
Total Expenditures:	80k

Objective of Project/Activity: ***(Provide short description of project/activity goals and list outcomes/products.)***

The U.S. Geological Survey has documented historical increases in nitrate levels in the Missouri and Mississippi River Basins. These increased nitrate concentrations have been implicated in the Gulf Hypoxia Syndrome (low dissolved oxygen zone) that threatens valuable marine fishery resources. High levels of nitrate result from a combination of factors including agricultural expansion and increased nitrogen application rates. These factors are exacerbated by land alterations including loss of riparian corridors, wetland drainage, and widespread use of tile drain systems. These alterations have basically altered the functional capabilities of the watershed for nitrogen assimilation, retention, and denitrification.

The U.S Geological Survey has extensive scientific capabilities in the areas of hydrology, water quality assessment, mapping, landscape analysis, biological assessment, and modeling that are critical in development of comprehensive efforts to understand and manage nitrate losses from Midwestern agricultural ecosystems. The Cedar River Basin of eastern Iowa has been identified as a Midwestern agricultural watershed with particularly high levels of nutrients. In addition, the Cedar River Basin is a major focus of the USGS NAWQA Program (Eastern Iowa NAWQA Region. Furthermore, the lower reach of the Cedar River between Waterloo and Cedar Rapids, Iowa has been listed on the States impaired waters list for high nitrate and bacteria concentrations. The first NAWQA cycle collected considerable spatial and temporal nutrient data that can serve as a data platform to explore testable hypotheses in relation to the fate and effects of nutrients in agricultural ecosystems. In recent years synoptic sampling studies and time of travel work through the USGS cooperative program have added to the knowledge of the Cedar River basin. To leverage these datasets, and to create integrated research opportunities within the USGS, the Central Region of the U.S. Geological Survey provided funds via the Central Region Integrated Science Program (CRISP) to conduct an assessment of the Cedar River Basin and factors related to elevated nitrate concentrations in streams. There were three objectives of this study: 1) Determine historical changes in land use in relation to watershed characteristics; 2) Assess historical changes in water quality that have occurred due to changes in land use, and 3) Determine the denitrification potential of soils among dominant microhabitats of the region.

Results indicate that dramatic changes have occurred in agricultural land use practices in the Cedar River Basin. The Basin is composed of 26 counties with a total human population of approximately 800,000 people. The human population has remained relatively stable over the past

30 years but has shifted from smaller towns to larger cities. The Cedar River Basin covers approximately 4.4 million acres in eastern Iowa and southern Minnesota. The total number of farmed acres has remained relatively constant at approximately 90% of the total acreage. However, dramatic changes in farming practices have occurred. The total number of farms has decreased due to the consolidation of small farms into larger farms. Corn and soybean acreages have increased while pasture and other crops have decreased. Nitrate levels in streams have increased steadily over the past 30 years in association with increased nitrogen fertilizer application. Modeling indicated that approximately 400,000 acres, or approximately 9% of total acreage, has denitrification potential (total 7.91% agricultural; 0.66% bottomland forest; 0.42% grassland; 0.13% backwater sloughs; and 0.13% water). Measurements of denitrification rates indicated that the highest potentials occur in the bottomland forest and grassed waterway habitats. However, denitrification rates varied widely within habitat types most probably due to variations in microbial populations.

Project/Activity Accomplishments: ***(What outcomes/products were achieved including what benefits were derived and by whom?)***

The results of this CRISP study have resulted in the following products:

Schnoebelen, D.J., J.F. Fairchild, P.J. Waisanen,, and S.J. Kalkhoff. 2003. Fate and transport of nitrate in the Cedar River Basin of Eastern Iowa. Presented at the Annual AWWR Meeting, Kansas City, MO, May 10-12, 2003.

Waisanen, P.J. , K. Verdin,, D.J. Schnoebelen, S., J.F. Fairchild, and S. Greenlee. 2003. GIS methodology for determining sources, fate, and transport of nitrate. Presented at 2003 ESRI Conference, San Diego, CA, July 7-11, 2003.

Fairchild, J.F. , D.J. Schnoebelen, P.J. Waisanen, S. Kalkhoff, K. Echols, K.Verdin, B.T. Johnson, and S. Greenlee. 2004. Historical Changes in Water Quality and Land Use in the Cedar River Basin, IA: Implications for and Management Activities to Increase Denitrification Rates. Final CRISP Report to the Central Region of the U.S. Geological Survey. 45 pp. In review.

These results have provided a dataset to promote discussions and future research projects among various agencies including the USGS, USDA, USEPA, and the States to re-examine land use activities and practices in relation to nitrate reduction approaches.

Final Results: ***(Describe how funds awarded were used to promote Director's goals of integrated science)***

Results were used to bring together researchers within the Biological Resources Division, the National Mapping Division, and the Water Resources Division of the U.S. Geological Survey in an integrated assessment effort. This project leveraged the results and information from previous projects in order to develop new datasets that can be used to seek further research partnerships and funding possibilities. Results are currently in draft report form and will be submitted in one or more peer-reviewed manuscripts.