

Mapping crop types to support water quality management in South Dakota

Summary

Clean water is essential to sustaining environmental and human health. The federal Clean Water Act requires that all states meet strict water quality standards. Pollution sources that threaten water quality are classified as point (e.g., leaking storage tanks, chemical spills) or nonpoint sources (NPS) (e.g., fertilizers, pesticides). Current water quality initiatives in South Dakota are focused on assessment and control of nonpoint pollutants. Pollutants most frequently identified in South Dakota include sediments, excess nutrients and fecal coliform bacteria.

The major sources of NPS pollution in South Dakota are associated with land use practices. Decision-making tools, such as computer models, need information on land cover to understand the relationship between land use and water quality. The USGS National Center for Earth Resources Observation and Science (USGS-EROS) is collaborating with the South Dakota Department of Environment and Natural Resources (SD-DENR) and the East Dakota Water Development District (EDWDD) to develop land use maps using Landsat satellite imagery to support water quality initiatives.

A Nonpoint Pollution Source Task Force comprised of state and federal agencies, local groups and citizens, producer groups and any others interested in NPS pollution meets regularly to provide advice and recommendations on all NPS activities in the state. South Dakota is recognized as having one of the best NPS programs in the nation.

Total Maximum Daily Loads (TMDLs) are an important tool for the management of water quality. The goal of TMDLs is to ensure that waters attain and maintain water quality standards. A TMDL is the the amount of pollution a waterbody can receive and still maintain water quality standards. TMDLs must be developed for waters that do not meet water quality standards. TMDL lists are updated every two years. Thirty-four of the approximate 165 nonpoint source TMDLs listed in 1998 and 2002 have been approved or de-listed.

States of SD Surface Water Quality (2002)

Approximately half of the rivers and major streams have been assessed for water quality; 44% were found to be unsuitable for their intended use and 14% only partially supported their intended use; pollutants were primarily from sedimentation and fecal coliform bacteria from agricultural nonpoint sources.

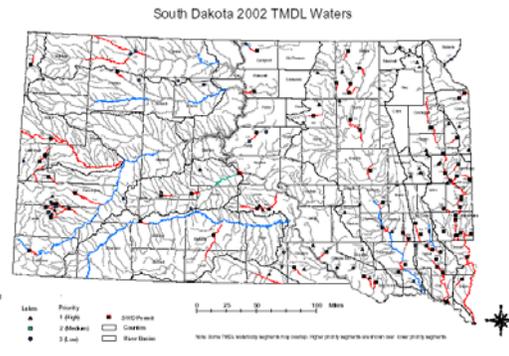
Of the lakes that have been assessed; 48% do not support their intended use and 20% only partially support their intended use; primary nonpoint sources of pollutants are sedimentation and nutrient runoff from agricultural land.

Wetlands came under the water quality standards in 1992; no wetlands have been assessed as of this date.

States of SD Ground Water Quality (2002)

145 water quality monitoring wells in 24 aquifers are currently tested; major sources of pollutants are from petroleum products (from leaking storage tanks and spills) and nitrate and nitrogen (from commercial and manure fertilizer use).

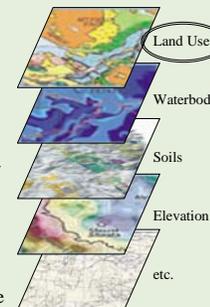
83% of public and private water supplies are provided by ground water; 2.7% of samples from public water systems were declared unsafe due to coliform bacteria contamination; 13% of samples from domestic water supplies exceeded water standards for nitrate-nitrogen and 26% of wells exceeded water standards for coliform bacteria.



Importance of Land Use Information

The **Annualized Agricultural Non-Point Source (AnnAGNPS)** Pollution computer model is being used to assist managers in determining what changes are needed to meet TMDL goals. AnnAGNPS is a continuous simulation, surface runoff model developed by the USDA Agricultural Research Service and Natural Resources Conservation Service.

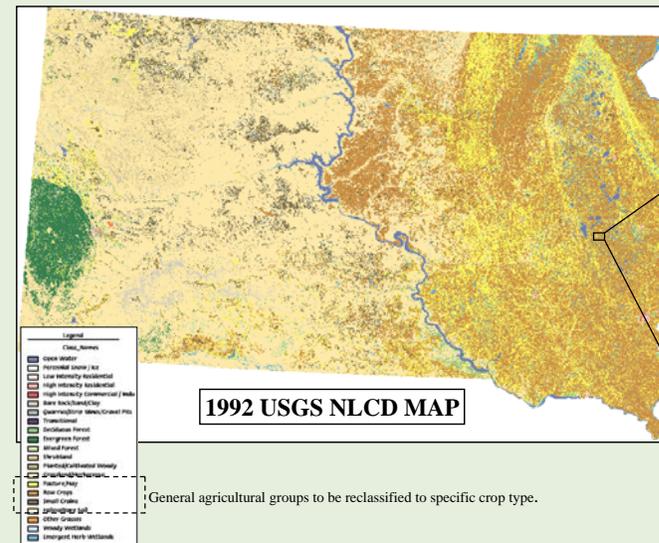
Land use land cover information is one of the many datasets needed as input to the model. Crop type in particular is required to determine nutrient loss and sediment erosion rates. The USGS National Land Cover Dataset (NLCD) map is being used for general land cover information, however further refinement of the map is necessary in order to identify specific crop types.



Refinement of the USGS National Land Cover Dataset (NLCD) map to crop type

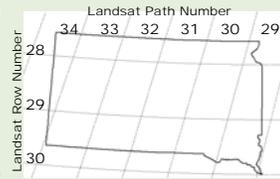
USGS National Land Cover Dataset (NLCD) Map

The 1992 USGS NLCD map will be used as the baseline map. The NLCD map identifies 21 land use / land cover classes – including 4 general agricultural groups (row crops, small grains, hay/pasture, fallow). These general agricultural groups will be refined using current Landsat satellite imagery.



Landsat Image Data Set

Over 100 Landsat images will be used in the development of crop maps for the entire State of South Dakota for the years 2000, 2001, and 2002 (17 images to completely cover the state of South Dakota, 2 images per year, 3 years).



Classification

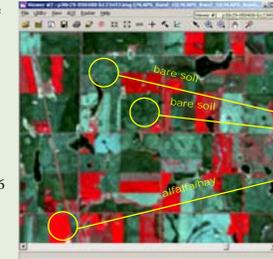
Early spring and late summer Landsat satellite images are used to distinguish individual crop species. Spring maturing crops (e.g., alfalfa, winter wheat) are classified using the early spring image and late summer maturing crops (e.g., corn, soybeans) are classified using the late summer image. Bivariate histograms of a near infrared and middle infrared band allow the analyst to rapidly identify and classify the major crops. The images below depict an area in Kingsbury County, South Dakota (lat: 44 16 04; long: 97 17 53).

Comparison of 1992 NLCD and 2000 NLCD Crop Map

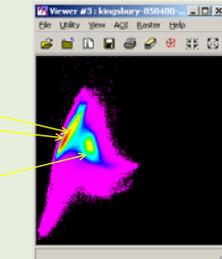


Original NLCD map and revised NLCD Crop Map with 2000 ground reference data overlaid. Location: Kingsbury County; lat: 44 16 04; long: 97 17 53. (A=alfalfa, B=soybeans, C=corn, WW=winter wheat)

May 4, 2000



Bivariate density scatter plots of Band 4 (near infrared) and Band 5 (middle infrared).



August 24, 2000

