# WATER FACT SHEET

*U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR*

# MANAGEMENT SYSTEMS EVALUATION AREA: IOWA - Walnut Creek Watershed

## BACKGROUND

The Management Systems Evaluation Area (MSEA) program is part of a multi-scale, interagency initiative to evaluate the effects of agricultural management (farming) systems--including such practices as irrigation, crop rotation, tillage, intercropping, and application of fertilizers and pesticides--on water quality. The program resulted from the integration of the U.S. Department of Agriculture (USDA) Research Plan for Water Quality and the U.S. Geological Survey (USGS) Mid-Continent Herbicide Initiative, and is part of the President's Water Quality Initiative. The mid-continent Corn Belt was selected for study because about 60 percent of the Nation's pesticides and nitrogen fertilizers are used there.

The USGS, Agricultural Research Service (ARS) and Cooperative State Research Service (CSRS) of the USDA, and the U.S. Environmental Protection Agency are collaborating on research at scales ranging from laboratory to small watersheds (about 20 square miles) with the following objectives: (1) to measure the effects of prevailing and modified farming systems on ground-water and surface-water quality; (2) to understand the processes and factors affecting the fate of selected agricultural chemicals; (3) to assess the effects of selected agricultural chemicals on ecosystems; (4) to assess the projected benefits to water quality of implementing modified farming systems; (5) to evaluate the socioeconomic impacts of using modified farming systems; and (6) transfer appropriate technology for use on the land.

Five MSEAs (fig. 1) were selected to represent the principal hydrogeologic settings and geographic diversity of prevailing farming systems in the region. MSEAs in sand and gravel settings are in Minnesota, Nebraska, and Ohio. Those in loess and till are located in Iowa and Missouri. Research is focused on ground-water processes in all areas, but stream processes also are a major consideration at areas in Iowa and Missouri.

## RESEARCH SITES IN IOWA

The Iowa MSEA project involves three primary agencies--USGS, ARS, and Iowa State University (through CSRS), working at four research sites in three different hydrogeologic settings--thin till over bedrock, thick till, and thick loess. Each site receives an average of about 32 inches of precipitation annually. General descriptions of each site, including the terrain, soils, and farming systems, are given below.

***Tillage Water-Quality Site near Nashua (northeast Iowa)*** -- The site is on gently rolling terrain of weathered till overlying a carbonate aquifer. The soils have slight to moderate permeability and a large water-holding capacity. Depth to bedrock is greater than 50 feet at the site, but can be less than 15 feet a few miles away. The study site consists of thirty-six 1-acre plots with three replications of three crop rotations--corn-corn, corn-soybean, and soybean-corn--and four tillage practices--moldboard plow, chisel plow, ridge till, and no till.


**Figure 1.** Location of MSEA (Management Systems Evaluation Area) sites in the Midwest.

***Deep Loess Research Station near Treynor (southwest Iowa)*** -- This area consists of four field-sized watersheds, 75 to 100 acres each, in steep, dissected terrain of thick loess soil overlying till. Surface drainage patterns are well defined, and shallow subsurface flow generally is to streams. The soils are highly erodible and have a large water-holding capacity. All four watersheds are cropped in corn--two with conventional fall chisel-plow tillage and two with ridge tillage.

***Till Hydrology Site near Ames (central Iowa)*** -- The site is on nearly level to gently rolling terrain of 200- to 300-foot thick till. Soil permeabilities are slight to moderate. The study site consists of eight 1-acre plots of corn, four each of moldboard plow and no till; in 1992 the area will be switched to a soybean-corn rotation with chisel-plow tillage.

***Walnut Creek watershed near Ames (central Iowa)*** -- The terrain is nearly level with numerous potholes in the upper one-third of the watershed, nearly level or gently rolling in most of the other uplands, and fairly steep near the streams in the lower part of the watershed (fig. 2). Downstream from the study watershed, Walnut Creek flows across the South Skunk River flood plain. Total relief is about 200 feet, and till thickness is from 200 to 300 feet on the uplands. Natural drainage is poor in the upper end of the watershed, and the use of subsurface drainage

tiles, surface inlets, and ditches is required. Soil permeabilities are slight to moderate. Within the watershed of about 18 square miles, study scales include subwatersheds (5 to 8 square miles), small basins (1 to 2 square miles), and field basins (10 to 80 acres). The northwestern and southwestern subwatersheds are almost completely agricultural and have large percentages of tile-drained land. The eastern subwatershed is steeper, with woodlands near some of the streams and smaller percentages of agricultural and tile-drained land. Alternative farming practices being studied include split nitrogen application (several smaller applications rather than one large application), banded pesticides (application only along the crop rows, not on the entire field), and ridge tillage. Narrow strip-intercropping, with a rotation of corn-soybean-grain-legume, may be studied in the future.

## HYDROLOGIC RESEARCH AT WALNUT CREEK WATERSHED

The USGS has three specific objectives that are an integral part of the overall objectives of the Iowa MSEA project. These specific objectives deal primarily with understanding the hydrologic system of the Walnut Creek watershed. Because water transports agricultural chemicals in both the dissolved and particulate phases, this understanding will help determine how farming systems affect ground- and surface-water quality in the watershed. Because of the complex nature of the overall Iowa MSEA project, the approach to meet the USGS objectives involves the cooperation of all three agencies. Significant progress was made during the 1991 water year. Two additional years of study are planned.

### Objectives

*Objective 1* – Define ground-water flow paths and movement in the saturated zone for selected basins.

*Objective 2* – Evaluate the ability of the USGS's Precipitation-Runoff Modeling System (PRMS) to simulate the major water/sediment flow processes in the watershed, and compare simulations with results from other models.

*Objective 3* – Relate the loadings of agricultural chemicals and sediment in watershed streamflow and tileflow to the major transport processes.

### Approach

Collect data on meteorological and agricultural inputs throughout the watershed and on surface-water, ground-water, and water-quality (agricultural chemicals) responses to those inputs at selected sites and at various scales. More specifically:

- Measure precipitation, surface runoff, tileflow, and streamflow continuously, and sample periodically.
- Measure ground-water levels biweekly and sample monthly.
- Several times during base-flow conditions, measure and sample streamflow and tileflow at numerous locations to determine the spatial distribution of ground-water inflow and quality.
- Sample precipitation, tileflow, and ground water during a storm, and analyze for stable isotopes of hydrogen and oxygen.
- Develop a geographic information system for the watershed to aid in the spatial analysis of data.
- Compute flows and chemical/sediment loadings for monitored sites.
- Simulate flow and sediment transport for monitored sites using PRMS and evaluate results.
- Compare types of flow and their associated loadings.

## REFERENCES

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Open-File Report 92-167

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1992

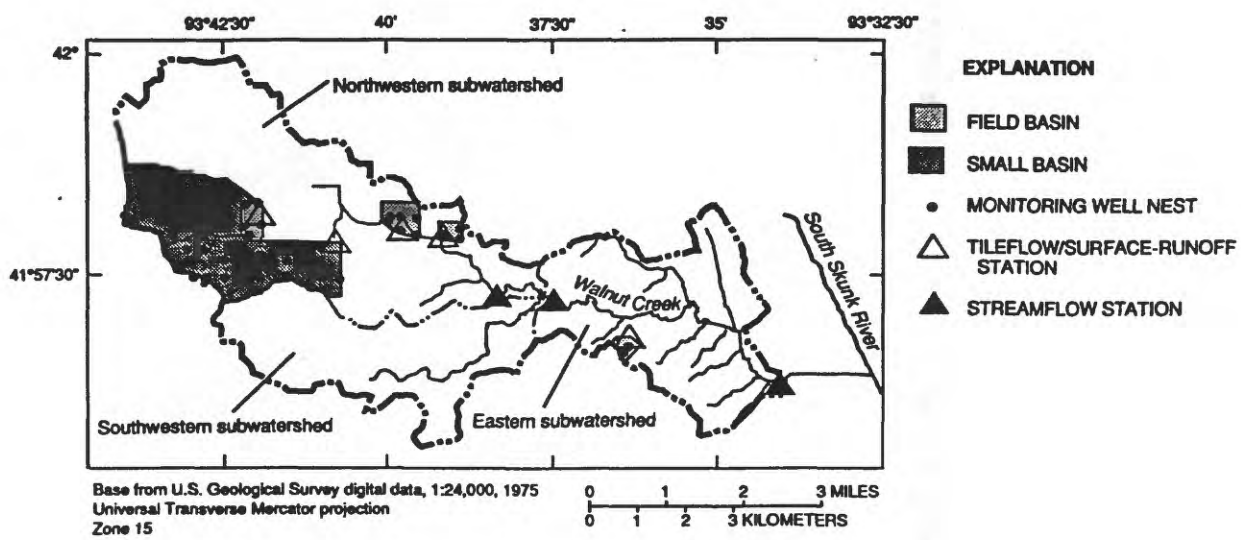


**Figure 2.** Walnut Creek watershed and study locations.

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