

# Devils Lake Basin Water Utilization Test Project

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## Executive Summary

Excessive precipitation since 1993 has led to rising water levels in Devils Lake and the surrounding basin, causing flooding and extensive property damage and loss. Solutions to mitigate flooding have included a proposal to use irrigation to divert water to the atmosphere via crop water use or evapotranspiration (ET). The Devils Lake Basin Water Utilization Test Project was conducted to determine whether irrigation can be used as a flood mitigation tool while providing an economic benefit. The primary objectives of the Test Project are to: 1) determine how much additional water from Devils Lake and associated water bodies can be utilized via sprinkler irrigation, 2) evaluate the effects of irrigation on representative soil map units within the basin, and 3) extrapolate the results from the test project to the broader basin. The Test Project was conducted on ten irrigated sites for three full growing seasons (2006 through 2008). Instrumentation was installed to monitor rainfall, irrigation, soil moisture, ground water levels, and downward fluxes of water through the soil profile. A remote sensing approach was used to estimate ET on a pixel-by-pixel basis for over one-half of the Devils Lake basin. Seasonal estimates of ET were determined for various crops for a best-case year with high evaporative demand and low rainfall (2006) to compare ET for irrigated crops on the Test Project sites with ET for largely nonirrigated crops in the remainder of the basin. Similar overlays of ET were used to compare ET for spring wheat and corn on selected soils. Spring wheat was selected for these simulations because of its predominance in cropped area in the basin, while corn was chosen as a contrast to spring wheat because of corn's longer growing season and higher expected seasonal ET.

Extensive soil sampling was conducted to monitor salinity, morphology, and other soil properties at the start of the project, throughout its duration, and at about half of the sites after three seasons of irrigation. Field-scale surveys were conducted each spring and fall to monitor changes in the extent and severity of soil salinity.

Results from ET modeling component of the Test Project indicate that irrigation appears considerably less promising as a flood mitigation tool than previous studies suggested. Specifically, a previous study suggested that about 9.8 inches of additional water utilization could be attained via irrigation in the Devils Lake basin compared with average values of water use for nonirrigated crops. Our results indicate that for the 2006 growing season, estimated ET was approximately 1.4 inches greater for irrigated corn at two sites in the test project compared with irrigated and nonirrigated corn in a larger study area within the basin. The 2006 season was relatively high in evaporative demand and low in rainfall compared with other years from 1995 through 2008, perhaps indicating that the 1.4 inches may be in the high range of the additional ET possible with irrigation. Moreover, at two other sites in the Test Project, the ET for irrigated corn was below the average for corn in the larger study area; this result further diminishes the prospects for using irrigation to increase ET as a means of

flood mitigation in the basin. The dominant soil series in the basin did not exhibit strong gains in estimated median ET for either spring wheat or corn compared with the median ET values for all soils. The differences between soils were generally smaller than the differences between corn and spring wheat. Specifically, switching from spring wheat to corn is expected to increase ET because of corn's longer growing season.

The ET modeling results lead us to believe that the Pilot Project, that is, expansion of the Test Project to include more irrigated area, should not proceed on the basis of using irrigation as a flood mitigation tool in the Devils Lake basin. The result of categorizing the seasonal ET estimates into soil and crop groups indicates that perhaps the best way to increase ET in the basin is to switch crops from spring wheat to corn. In a more general sense, longer-season crops and full-cover vegetation offer higher seasonal values of estimated ET compared with relatively short-season crops.

The results for soil salinity have not been completed to date because additional sampling during the 2009 growing season will be required. Half of the sites were inaccessible for fall 2008 soil sampling because of wet conditions and late or no crop removal. The Devils Lake Basin Joint Water Resource Board approved a one-year no-cost project extension to attempt completion of the soil sampling field work in the 2009 growing season. Subsequent laboratory work and data analysis will be conducted during late 2009 and early 2010