New tool speeds ID, evaluation of potential water storage sites

TEST SITES: BWSR tested the framework in three watersheds: the Buffalo-Red River Watershed District near Moorhead, the Yellow Medicine River Watershed District in west-central Minnesota, and the Cedar River Watershed District in south-central Minnesota near Austin. The outcomes complement watershed plans and the use of PTMApp to identify and prioritize best management practices for water-quality benefits. In a watershed-based process, the data, tools and models produced in this project should accelerate water storage project planning, which complements the water quality and storage grant program developed in 2021, and funded again by the Minnesota Legislature in 2023.

A new resource will make it faster, easier and less expensive for local governments to evaluate potential water storage sites. The Strategic Framework to Guide Local Water Storage Implementation will be available as early as this month.

Minnesota Board of Water and Soil Resources (BWSR) staff members developed the framework. A $200,000 grant from the Legislative-Citizen Commission on Minnesota Resources (LCCMR) funded the project.

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

The late-June floods that damaged infrastructure and crops across parts of Minnesota illustrated the need for water storage. That need has grown over the years as the effects of climate change have brought increasingly heavy and frequent rains, and as intensive drainage has sped runoff and reduced available water storage on the landscape.

A storm that brings an extra inch of rain may not sound like much, but over 1 square mile that equals 53 acre-feet of water — more than 17 million gallons, enough to fill more than 26 Olympic-sized swimming pools.

“This project creates the guidance, data and tools to clearly identify, prioritize, and evaluate water storage opportunities within a watershed.”

— Luke Olson,
BWSR board conservationist

State and local plans have identified the need to add water storage to reduce soil loss, cut ditch maintenance, curb stream channel erosion, mitigate flood damage and improve water quality. The state’s Climate Action Framework identifies water storage as a priority. Throughout Minnesota’s agricultural regions, comprehensive watershed management plans (CWMPs) have identified, and even required, goals related to water storage.

Local governments needed a process to move from planning to implementation.

“Local focus has traditionally been on conservation projects that address wind and water erosion,” said Luke Olson, Marshall-based BWSR board conservationist. “Local staff and boards understand the need for water storage

The following are examples of the types of water storage projects that a new tool developed by BWSR staff can identify and help to prioritize. A roadside retention basin in Yellow Medicine County, **left**, *seen in spring 2023, was designed to reduce the amount of sediment that reaches Dell Clark Lake near Canby.* **Photo Credit:** Lac qui Parle-Yellow Bank Watershed District

Basins constructed in Yellow Medicine County, **middle**, *seen in fall 2022, will decrease the amount of sediment that reaches Dell Clark Lake.* **Photo Credit:** Yellow Medicine SWCD

A grade stabilization, **right**, *is seen in October 2019 in Lyon County.* **Photo Credit:** Area II Minnesota River Basin Projects

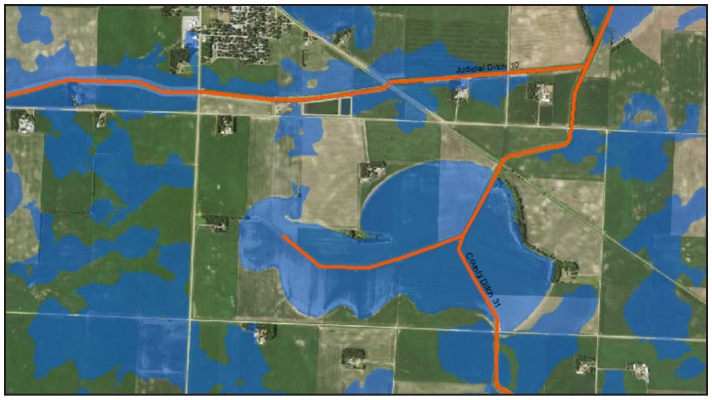
but have never really had a straightforward process to identify and implement these types of projects. This project creates the guidance, data and tools to clearly identify, prioritize, and evaluate water storage opportunities within a watershed."

The framework BWSR developed plots a strategy for local government staff to start working with landowners to implement water storage projects. It builds on the state's investment in high-resolution topography data, Light Detection and Ranging (LiDAR), to find the topographic "signature" of three types of water storage projects: natural depressions, drained basins, and areas with topography and a water supply necessary to build artificial impoundments.

"LiDAR data gives us the opportunity to use Geographic Information Systems (GIS) to conduct a detailed analysis of every square foot of a watershed area to identify potential water storage sites" said Henry Van Offelen, a Detroit Lakes-based BWSR clean water specialist who managed the LCCMR-supported project.

"Not only can we identify storage sites, we can also estimate their physical attributes such as water storage capacity and drainage area and other characteristics related to project feasibility, such as whether buildings are present in the storage area or whether there are numerous landowners. Deriving the physical attributes of the storage sites is key to being able to prioritize the sites and evaluate whether they can meet a watershed group's goals," Van Offelen said.

The framework was developed by using and refining GIS tools in two areas



A map illustrates potential water storage sites. **Image Credit:** BWSR

with clear water storage needs: the Buffalo-Red River and Yellow Medicine River watershed districts. International Water Institute staff identified and updated GIS models to pinpoint potential sites, and helped to develop the scoring system. Houston Engineering Inc. (HEI) staff created a GIS toolbar using those models and an existing hydrology model. Those refined tools will be applied to ongoing work in the Cedar River watershed.

Once the water storage data is collected, a strategy is developed in a three-step process involving local watershed group meetings.

First, the group reviews the goals and priority areas in its CWMP. Setting a clear hydrology goal — a 10-year peak flow goal — is critical to evaluate success.

In the Buffalo-Red River Watershed District (BRRWD), the group focused on the highest priority planning regions. The Yellow Medicine River Watershed District (YMRWD) set a watershed-wide goal. The Cedar River Watershed District focused upstream from Austin.

The second step is to screen, score and prioritize potential water storage sites. The group narrows the list based on site characteristics. The framework includes a scoring process based on local priorities.

Within the BRRWD priority area, the group was most interested in constructing larger off-channel storage sites. The data helped to screen dozens of potential sites, and then set priorities based on scoring storage capacity, drainage area and number of landowners.

The YMRWD used land use and storage capacity as primary factors for scoring and prioritizing. It focused on locating sites in one area of the watershed.

"Our local watershed group appreciated being able to review the large number and variety of potential water storage sites and apply our own local scoring system to prioritize them," said YMRWD Administrator Michelle Overholser. "The GIS analysis presented thousands of sites. We had to narrow down the list to a manageable number that we could evaluate. We were able to do this and look at hydrographs to help us further refine our list of best options."

The third step involves evaluating the effects of priority storage sites on hydrology. For the YMRWD, it was necessary to develop a hydrology model that was easy to use and could generate results during a meeting. The key to the model, Van Offelen said, is the ability to see and review results in person. Previously, it could take days or weeks for a consultant to return to the office, run the model, interpret the results, and then present the findings.

The project refined a model HEI developed for the Minnesota Soybean Research & Promotion Council, making it easier to use and immediately generate results. With hydrographs in hand, a watershed planning group can further narrow the number of sites and determine which landowners to contact first, speeding the planning-to-implementation process.

The resources needed to identify water storage sites will be available as a toolbar that builds on data developed by BWSR's Prioritize, Target, and Measure Application (PTMApp). The new model allows the user to input water storage sites and readily generate hydrographs for existing and post-project conditions. Before this planning model was developed, anyone considering a water storage project would have to invest thousands of dollars to develop a hydrologic model. With this GIS-based model, a watershed group can evaluate scenarios to determine which sites are most likely to achieve their goals.

"The new model gives local groups a great planning tool to quickly compare the likely effects that water storage sites will have on hydrology downstream," said Bennett Uhler, an HEI engineer contracted to provide services to the BRRWD. "The ability to work with a group in real time to evaluate different storage options should help accelerate planning and implementation of water storage projects."