CENTER FOR LAKES & STREAMS™ GRACE COLLEGE

Water level influences for Wawasee and Syracuse lakes in 2011, 2012, and 2013

Executive Summary

In 2012, the lake levels of Wawasee and Syracuse dropped about 18 inches below normal. The purpose of our expanded study was to evaluate the causes of lake level changes during normal years (taken as 2011 and 2013) and a drought year (taken as 2012). To answer these questions, we developed a lake water budget (inflows and outflows directly to and from the lake) and a watershed water budget (inflows and outflows from the entire drainage area).

Lake Water Budget
The lake water budget took into consideration water entering the lakes (inflows) and water leaving the lakes (outflows). The inflows consisted of water entering the lakes through precipitation, streams, and groundwater (i.e. springs). The outflows consisted of water leaving the lakes through evaporation, the Syracuse dam, and irrigation being taken directly from the lakes.

Study results showed that precipitation in 2012 was only about half of the amount of precipitation in 2011. The decrease in rain also affected inflowing streams. With low rainfall around the lakes, the streams delivered even less than half of the water in 2012 than they did in 2011. Though an increase in groundwater flowing into the lakes in 2012 was able to compensate for some of these decreases, the total inflow into the lakes still decreased from 2011 to 2012.

Lake outflows also changed. Evaporation increased in 2012 because of warmer temperatures in the Midwest. Water leaving through the dam decreased from 2011 to 2012 because once the water level fell below the spillway, the dam did not release any more water. So while 60% of all water leaving the lakes in 2011 left through the dam (as opposed to water leaving through evaporation and irrigation), only 30% of all water leaving in 2012 was through the dam. As for residential irrigation, it accounted for 2% of all water leaving the lakes in 2011, but increased to account for 3% of all water leaving the lakes in 2012.

This means that in 2012 the lakes had less water entering them and more water leaving them, which led to extremely low lake water levels.

This study demonstrates that the main causes of the changing lake levels are uncontrollable factors. Lake managers and property owners cannot control the amount of water that enters the lakes through rainfall, groundwater, and the streams, nor do they have control over how much water leaves the lake and enters the atmosphere through evaporation. But for the factors that lake managers and property owners can control, it would be beneficial to anticipate drought situations as early as possible in order to have the greatest impact. Anticipating a drought would allow using the dam to hold back as much water as possible before water levels fall below the spillway and the dam no longer can help. Anticipating a drought would also allow lake residents to employ self-imposed rationing of lake water used for irrigation. This study showed that irrigation systems were not as influential as first thought but still impact the lake.

Watershed Water Budget

The watershed water budget took into consideration water entering the watershed (inflows) and water leaving the watershed (outflows). The only inflow to the watershed was precipitation. The outflows consisted of evapotranspiration (evaporation from the lake plus water leaving plants in the surrounding land) and the Syracuse dam. Although groundwater and irrigation were not used in calculating the watershed water budget, that data was used for comparison and analysis.

At the watershed level, any changes in groundwater are just changes in aquifer storage (an aquifer is simply an underground area with gravel or sand particles where groundwater is stored around these particles), so they are not used for calculating the watershed water budget. But the changes in aquifer storage were included for reference. In 2011, 33.3 million m^3 of water was being transferred into the aquifer under the surface of the watershed; whereas in 2012, the aquifer lost 6.5 million m^3 of water. In a normal year, 2011, there was enough precipitation and stream flow in the watershed area to allow water to soak into the ground and flow into the aquifer. In a drought year, 2012, less water was coming into the watershed from rainfall even while evapotranspiration and dam outlet losses continued, so the aquifer was not able to recharge.

Like groundwater, significant wells in the watershed are included in this study for comparison, especially due to interest in recent expansion of agricultural wells. The total amount of water taken out of the aquifer by these wells was almost 1 million m^3 of water in 2011, which accounts for about 1% of precipitation inputs to the watershed. In 2012, there was an increase to a total of 1.4 million m^3 taken by these wells. This accounted for 2% of the precipitation for the watershed in that year.

The hypothetical addition of 20 new agricultural wells, in addition to the 17 wells already in the watershed, was also quantified for reference. This was accomplished by selecting the largest existing agricultural well each year in the watershed and projecting the addition of 20 more wells pumping at that same maximum rate. An additional 8 million m^3 of water would be taken out of the aquifer per year on average under these conditions. When combined with the existing wells, this would account for about 10% of annual precipitation. This potential increase in agriculture irrigation would be relatively small compared to the total watershed budget in a normal year, but could exacerbate low water levels like residential irrigation during drought years. The expansion of agricultural irrigation systems is something to continue to monitor.

This is a supplement to a study conducted by the Center for Lakes & Streams at Grace College, a center for applied research, education, and collaboration. A more technical report entitled, Quantification of lake water level influences for Wawasee and Syracuse lakes: Lake and watershed water budgets for 2011, 2012, and 2013, is available on our website at lakes.grace.edu.