Calculating Annual Flood Damages Reduced using the Corps Water Management System

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Abstract

Computing annual flood damages reduced using the Corps Water Management System (CWMS) modernizes the Annual Flood Damages Reduced estimates developed by U.S. Army Corps of Engineers (USACE) District Offices. This approach to estimate annual flood damages reduced uses the latest spatial structural and/or agricultural inventories, inundation mapping, and reservoir operations to develop a more informed and realistic picture of how USACE dam and levee projects reduce flood damages across the nation every year.

Each year, USACE District Offices are required to report the total dollar value of flood damages reduced by their dam and levee projects. The total flood damages reduced for each District are combined into a single annual report organized by state, which USACE Headquarters then delivers to Congress. Historically, flood damages reduced have not been consistently calculated across the country. Most USACE Districts used some sort of legacy aggregated stage-damage curves. These curves were usually created when the project was first built, and often have minimal documentation on the assumptions and data used for their development. One stage-damage curve would represent an entire river reach, usually tied to a local stream gage. For each flood event the max stage at the local gage would be entered on the stage-damage curve, providing the flood damages reduced for the floodplain. While these aggregated stage-damage curves are indexed for inflation each year, they do not consider any changes to land use in the floodplain. Decades of housing construction or increased agricultural use since development of the stage-damage curves would not be accounted for in the flood damages reduced calculations. Similarly, these curves would not reflect any future changes in land use.

Over the last decade, USACE has developed CWMS models for watersheds across the country through the CWMS National Implementation Plan. CWMS models integrate real-time data acquisition, database storage, flow forecasting of watershed runoff, reservoir operation decision support, river profile modeling, inundated area determination, consequence/damage analysis, and information dissemination into a comprehensive suite of software, supporting water management decision processes. For a specific flood event, the USACE District can use the CWMS model to simulate a scenario to determine what the flood inundation and flood damages would be if the USACE dams and levees were not present. The map in Figure 1 compares the inundation extent for an event on the Mississippi River with the simulated without levee inundation. This type of comparison within the CWMS modeling system visually highlights the benefits of USACE infrastructure. These damages can then be compared against a CWMS simulation of the actual event, estimating the flood damages reduced by the USACE projects. Recent improvements in HEC-Flood Impact Analysis (HEC-FIA) allow for streamlined flood damages reduced calculations and reporting within CWMS. This approach replaces legacy stage-damage curve methods that may not depict the current conditions in the watershed.

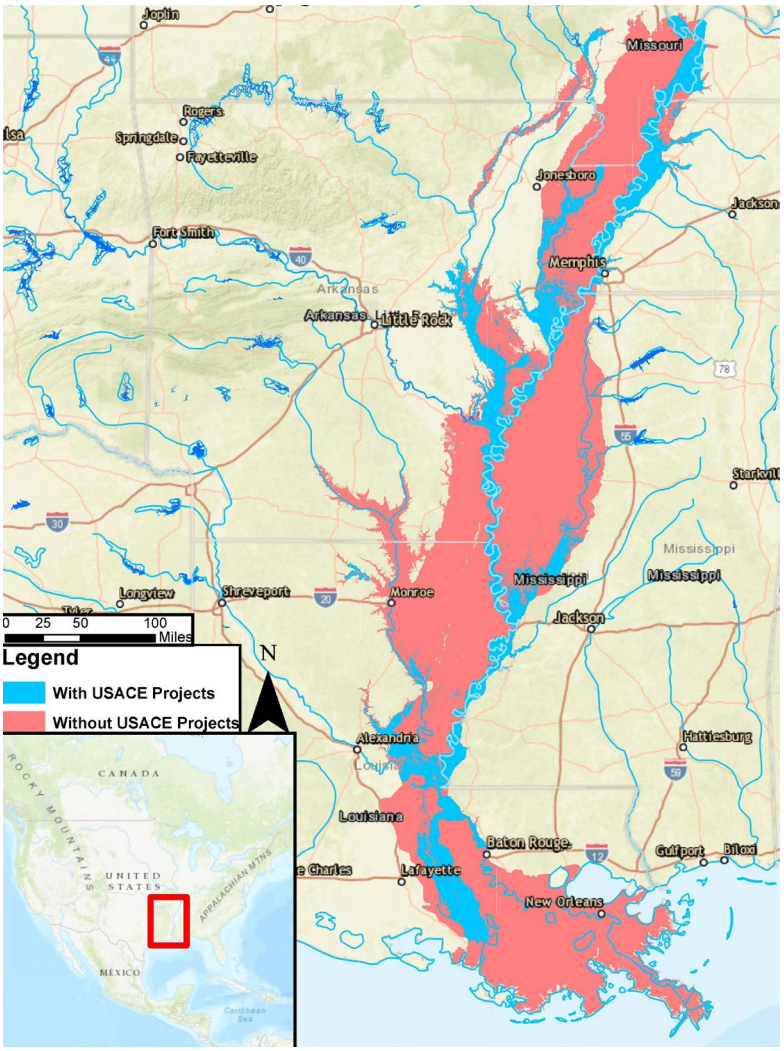

Figure 1: Comparison of With USACE Project versus Without USACE Project inundation for a theoretical event on the Mississippi River.

Baltimore District is responsible for the operation of sixteen reservoirs in the Susquehanna River and Potomac River watersheds. The reservoirs are located in New York, Pennsylvania, Maryland, and West Virginia. Baltimore District has developed CWMS models for all of the reservoirs, and began testing the use of CWMS for calculating annual flood damages reduced in FY2020. A comparison between the legacy flood damages reduced methodology and the CWMS methodology showed a 250 percent increase in calculated benefits for the Upper Susquehanna River reservoirs (Whitney Point and East Sidney) for FY2020. This increase demonstrates the under accounting of project benefits of the legacy stage-damage curve methodology when compared to the CWMS modeling approach. Baltimore District transitioned to using CWMS to report annual flood damages reduced starting in FY2021. The annual flood damages reduced for FY2021 are shown in Figure 2 for the Baltimore District projects, organized by sub-watershed. The reservoir benefits for FY2021 were mainly centered in the Chemung River. This was due to a December 2020 storm, and the remnants of Tropical Storms Fred and Ida in August 2021 that mainly impacted the Chemung River watershed, while sparing other Baltimore District reservoirs.

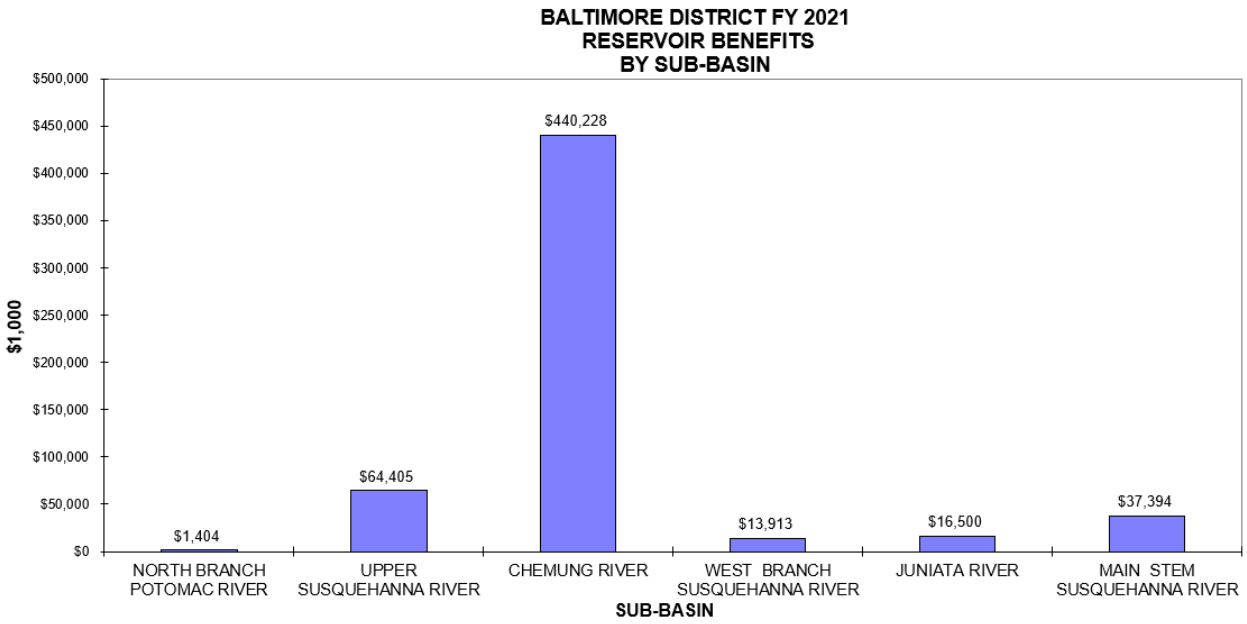

Figure 2: Baltimore District FY2021 Flood Damages Reduced for Reservoirs

Approximately twenty percent of USACE Districts have already transitioned to using CWMS to compute annual flood damages reduced, and the remaining Districts are actively working towards this goal. This new methodology of calculating annual flood damages reduced by leveraging CWMS models allow USACE Districts to better estimate the dollar value of flood damages reduced by their dams and levees, as well as broadcast the benefit of USACE projects to the nation.