2010-TPF-5(187)TS
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TRANSPORTATION POOLED FUND PROGRAM

TECHNICAL SUMMARY

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TOTAL AGENCY CONTRIBUTIONS TO DATE:

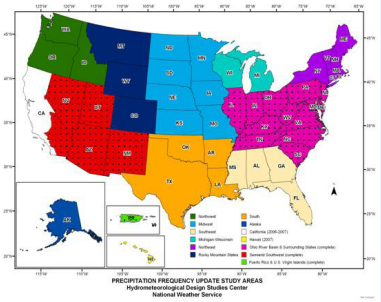
$1,307,437

Mn/DOT AND CITY STATE AID CONTRIBUTIONS TO DATE:

$182,374

PARTICIPATING STATES:

CO, IA, KS, MI, MN, MO, NE, ND, OK, SD, WI



NOAA is updating precipitation frequency estimates by geographic region and, in some cases, for single states (such as California).

RESEARCH SERVICES

OFFICE OF POLICY ANALYSIS, RESEARCH & INNOVATION

Pooling Our Research: Updating Precipitation Frequency Estimates

TPF-5(187): Updating U.S. Precipitation Frequency Estimates for the Midwestern Region. *This multistate pooled fund study is updating decades-old precipitation frequency estimates that are used by practitioners to design small drainage structures such as inlets, storm drains and small culverts.*

Why a Pooled Fund Study?

Hydraulic engineers use precipitation frequency estimates to determine runoff and flow rate when designing storm drains, ponds, culverts and water quality devices to ensure they are adequately sized to handle the water quantity. If the structures are too small, flooding occurs; if they are too big, designers are wasting money.

In some parts of the country, including Minnesota, some precipitation frequency estimates used to design small drainage structures have not been updated for 50 years.

States like Minnesota without updated estimates use data from the 1961 publication Technical Paper No. 40 in equations to determine runoff. Information from the 1977 Tech Memo HYDRO-35 is used to create rainfall intensity-duration-frequency curves—graphical representations of the amount of water that falls within a given period of time—for typical design frequencies. These design frequencies are computed using the probability that a flood flow will be exceeded in a given year. For example, if a flood has a 2 percent chance of being equaled or exceeded each year, over a long period of time that flood will be equaled or exceeded on average once every 50 years.

There is some evidence—and this reflects widespread perception in the technical community—that rainfall patterns have been changing, and the precipitation data used by Minnesota transportation agencies is outdated. This means that the resulting hydraulic designs may not be as accurate as possible.

The National Oceanic and Atmospheric Administration, a recognized expert in precipitation analysis, has updated precipitation data for parts of the country in various volumes of NOAA Atlas 14, Precipitation-Frequency Atlas of the United States with funding from regional climatic centers and other pooled funding arrangements. In 2008, Minnesota helped create a new pooled fund study to generate precipitation frequency estimates for participating states using the same state-of-the-art statistical techniques NOAA has applied to updates for other regions of the country. Minnesota's share of this study is financially supported by Mn/DOT research funds, the Legislative-Citizen Commission on Minnesota Resources through the Minnesota Pollution Control Agency, and Minnesota cities with State Aid funds.

What is the Pooled Fund Study's Goal?

The goal of this pooled fund study is to review and process available rainfall data for participating states to update precipitation frequency estimates for durations ranging from 5 minutes to 60 days and for average recurrence intervals, or ARIs. An ARI is the long-term average number of years between the occurrence of a flood as big as or bigger than a selected event.

What Have We Learned?

During the first year of this three-year project, researchers evaluated a list of potential data sources, updated and formatted all data sets and conducted initial data quality con-

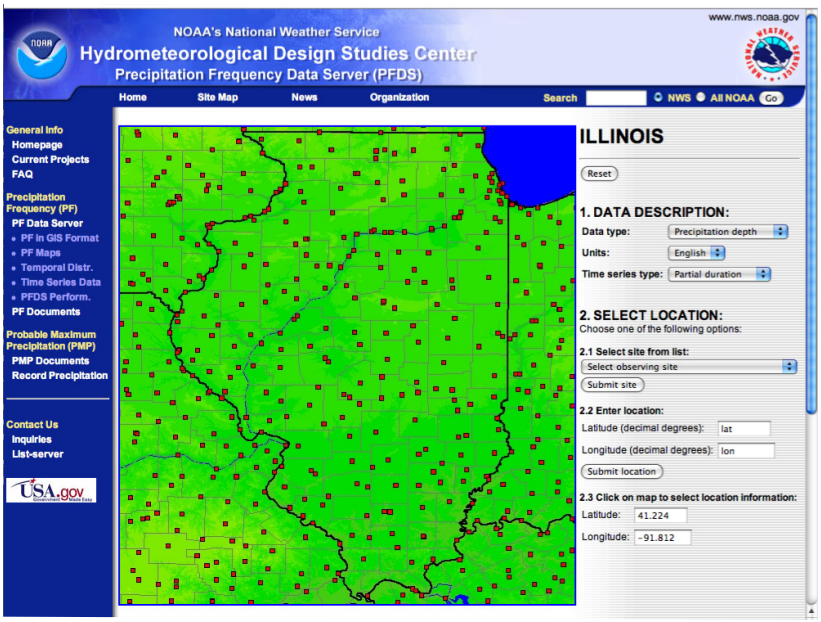
continued

"The precipitation frequency estimates used to design Minnesota's drainage infrastructure are, in some cases, 50 years old. The precipitation data developed in this study will use the best available data, helping us to make the best design decisions."

—Deb Bloom,
City Engineer, City of Roseville, Minnesota

"Mn/DOT's participation in this national project means that the same process and procedure for precipitation frequency estimates will be employed statewide."

—Andrea Hendrickson,
Mn/DOT State Hydraulics Engineer



This screen shot shows how users are prompted to gather precipitation frequency data from NOAA's Precipitation Frequency Data Server for Illinois, one of the states included in NOAA Atlas 14, Volume 2. Users will see a similar point-and-click, map-based screen of Minnesota when this pooled fund project is complete.

trol. Data sets for Minnesota included data from 344 Minnesota sites that provide one-day data sets, and data from the Metropolitan Council Environmental Services' metering and alarm rainfall database that includes 15-minute interval reporting from 22 stations. Additional quality control and data reliability tests included examining outliers, screening data for duplicate records and identifying candidates for merging reporting stations.

What's Going On Now?

Researchers are continuing with data analysis, which includes regional frequency analysis based on L-moments statistics—an alternative way of describing frequency distributions. Because L-moments are linear combinations of ranked observations, they are less subject to bias in estimation than other statistical methods. Other activities include the use of algorithms that test internal consistency at observing locations and the development of homogeneous regions—or sets of observing locations—that are expected to reduce the error associated with estimates.

What's Next?

Researchers estimate that study results will be published in May 2012 as a new Web-based volume of NOAA Atlas 14, with the Precipitation Frequency Data Server providing access to mapping, charts and related reporting. With data delivered via the Web, users can incorporate digital versions of the estimates directly in their applications, eliminating an expensive and error-prone digitizing step that was required in the past.

Precipitation frequency estimates will be presented in geographic information systems-compatible formats, including estimates at a given point on a map (after entering the latitude and longitude); distributions of heavy precipitation for durations of six, 12, 24 and 96 hours; charts of the seasonal distribution of the maximum 24-hour rainfall occurring annually; and cartographic maps of precipitation frequency estimates with 90 percent upper and lower confidence intervals for assorted durations.

This Technical Summary pertains to the ongoing Pooled Fund TPF-5(187), Updating U.S. Precipitation Frequency Estimates for the Midwestern Region. Details of this study can be found at http://pooledfund.org/projectdetails.asp?id=410&status=4.

For more than 25 years, FHWA's Transportation Pooled Fund Program has been providing state DOTs and other organizations with the opportunity to collaborate in solving transportation-related problems. The TPF Program is focused on leveraging limited funds, avoiding duplication of effort, undertaking large-scale projects and achieving broader dissemination of results on issues of regional and national interest.

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