**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

Lead Agency (FHWA or State DOT): \_\_\_**FHWA**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

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| **Transportation Pooled Fund Program Project #**  TPF-5(475) | | **Transportation Pooled Fund Program - Report Period:**  □ Quarter 1 (January 1 – March 31)  □ Quarter 2 (April 1 – June 30)  □ Quarter 3 (July 1 – September 30)  X Quarter 4 (October 1 – December 31) | |
| **Project Title:**  Update Precipitation Frequency Estimates for Delaware, Maryland, North Carolina, Virginia, Pennsylvania, and South Carolina (NOAA Atlas 14, Vol. 13) | | | |
| **Name of Project Manager(s):**  Megan Frye | **Phone Number:**  (303) 396-9847 | | **E-Mail**  megan.frye@dot.gov |
| **Lead Agency Project ID:**  FHWA | **Other Project ID (i.e., contract #):** | | **Project Start Date:**  March 19, 2021 |
| **Original Project End Date:**  June 2024 | **Current Project End Date:**  December 2025 | | **Number of Extensions:** |

Project schedule status:

□ On schedule □ On revised schedule □ Ahead of schedule X Behind schedule

Overall Project Statistics:

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| **Total Project Budget** | **Total Cost to Date for Project** | **Percentage of Work**  **Completed to Date** |
| $1,802,000 | $833,728 | 46% |

***Quarterly*** Project Statistics:

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| **Total Project Expenses**  **and Percentage This Quarter** | **Total Amount of Funds**  **Expended This Quarter** | **Total Percentage of**  **Time Used to Date** |
| $180,000 / 10% | $180,000 | 77% |

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| **Project Description**:  The purpose of this project is to update precipitation frequency estimates for Delaware, Maryland, North Carolina, Virginia, Pennsylvania, and South Carolina published in NOAA Atlas 14 Volume 2. Like previous NOAA Atlas 14 volumes, the estimates and associated bounds of 90% confidence intervals will be provided at 30 arc-sec resolution for durations of 5-minute through 60-day at average recurrence intervals (ARIs) of 1-year through 1,000-year.  The study results will be published as NOAA Atlas 14 Volume 13, a wholly web-based publication available at Precipitation Frequency Data Server (PFDS). The publication will include the artifacts provided in previous NOAA Atlas 14 Volumes, including access through the PFDS, base grids in standard formats together with error estimates, electronic copies of maps, charts of seasonal distributions and probabilistic temporal distributions of heavy precipitation, and detailed documentation.  Updated areal reduction factors, which are needed to calculate analogous areal precipitation frequency estimates, will not be developed as a part of this project. |

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| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**  In this reporting period, NOAA completed the modernization of the station cleanup software and initiated the manual station cleanup for the co-located NCEI networks. Several datasets were extended through 2024. In addition, NOAA continues quality controlling the station metadata and high outlier checks. Finally, NOAA continues investigating the development of the mean annual maxima grids for this project area.  Additional information on the status of the Atlas 14, Volume 13 work is available at:  https://www.weather.gov/owp/hdsc\_current\_projects |
| **Anticipated work next quarter**:  In the next quarter, NOAA will finish data collection, reformatting, and quality control on data received for 2024, which includes data from Helene. In parallel, they will finish developing MAM grids for base durations for the development of the preliminary estimates over this domain.  NOAA will review maps of the resulting estimates for the 2-year and 100-year ARIs. Inconsistent estimates or unreasonable patterns are resolved on a case-by-case basis in various ways: by manually adjusting the value to reflect expected patterns, omitting the station from the analysis, or by adding anchoring estimates at critical ungauged locations. |

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| **Significant Results:**  **Data Collection and Screening** - NOAA continues to quality control the identified precipitation networks that are considered for the development of the Atlas 14 Volume 13 estimates. As with all NOAA Atlas 14 Volumes, the primary source of data is the NOAA’s National Centers for Environmental Information (NCEI). The NCEI is the most reliable data source network in the United States.  **Station Metadata Screening** - NOAA continues to perform manual metadata inspection for datasets formatted (Table 2), and thus far completed the 95% of the metadata checks for all networks.  All NCEI datasets have been prescreened using the Python-based software that has been developed to modernize and automate our station metadata quality control process. Only stations that have failed two tests: elevation differences between the station metadata and DEM over 150 m and locations outside of the 1-minute precision box, were manually inspected for the metadata corrections. In this reporting period, NOAA continues to perform manual metadata inspection for datasets formatted and thus far completed the 95% of the metadata checks for all networks.  **Station Cleanup -** The station cleanup effort is performed to:   * screen for duplicate records * extend records at longer-duration stations using data from nearby stations * investigate large differences in annual maximum series (AMS) at collocated stations at critical * durations such as 1-hour and 1-day * implement data corrections to ensure data consistency across multiple gauges * determining if overall datasets are of good quality and should be used in the analysis   In this reporting period, NOAA implemented two rounds of automated merges:   * The automerge now runs 2 rounds of merges, the first with a 0.5 mile radius, the second with a 3.0 mile radius. In the second round merge, all deleted and stations incorporated into other stations via merges are excluded from grouping. In the second round merge, stations merged in the first round are reset so that the merges are in order of longest to shortest record. * A check was implemented for stations’ mean annual precipitation (MAP) from the Parameter-elevation Relationships on Independent Slopes Model (PRISM) during grouping of stations for possible merging. The MAP ratio (group min MAP/group max MAP) to determine when to split groups into 2 or more groups and/or prevent automatic merging of stations in the group (e.g. MAP values are too different for stations to be auto-merged).   M**ean Annual Maxima (MAM) grids for base durations -** During this reporting period, NOAA generated initial versions of MAM grids for base durations (1 hour, 6 hours, 24 hours, and 10 days). They also investigated a third analysis (to follow the ordinary kriging step) which adjusts small-scale (50-100 km) residual errors in the analysis to better match station values, using radial basis function (RBF) interpolation. At this time, more work is needed to evaluate this step's performance and skill.  NOAA continues to use cross-validation methods to optimize configurations and evaluate the results of our MAM analyses, and continue managing the code produced for this effort (mostly Python) on GitHub.  **Extraction of the Rainy Season -** During this reporting period, Python code was developed in order to extract the months when a majority of the Annual Maximum Series is occurring. NOAA refers to this as the rainy season. The percent of AMS occurring in each month is calculated. Then a moving window is used to determine which span of months contain at least ⅔ of the total annual maximum series.  In the event where there are multiple spans of months that contain ⅔ of the total AMS, the months that contain the larger percentage of AMS are considered the rainy season. If the tie cannot be broken based on AMS percentage, a wider range of months is used.  During the next reporting period, climate regions will be delineated based on spatial variations in the rainy season across the project area.  **Development of Precipitation Frequency Estimates -** During this reporting period, we developed initial gridded precipitation frequency estimates for durations between 1-hour and 10-days and for up to 100-year average recurrence intervals (ARIs). |
| **Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that**  **might affect the completion of the project within the time, scope and fiscal constraints set forth in the**  **agreement, along with recommended solutions to those problems).**  Delay in finalizing the IAA with NOAA. Estimated timeline to complete the work is late 2025 now.  Current schedule:   * *Data collection, formatting, and initial quality control [Q4 2024; Completed]* * Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, independence, consistency across durations, duplicate stations, candidates for merging)] [Q1 2025; In Progress] * Regionalization and frequency analysis [Q1 2025; In Progress] * Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [Q2 2025; In Progress] * Peer review [Q2 2025; In Progress] * Revision of PF estimates [Q2 2025] * Remaining tasks (e.g., development of precipitation frequency estimates for partial duration series, seasonality, temporal distributions, documentation) [Q4 2025] * Web publication [Q4 2025] |

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| **Potential Implementation:**  All deliverables will be accessible through the Precipitation Frequency Data Server (PFDS). That includes:   * Interactive map of the United States. Via this map, IDF/DDF tables and curves will be available for any location in the project area. * Precipitation frequency grids in GIS compatible formats. * Metadata in Federal Geographic Data Transfer Standard format. * Cartographic maps of precipitation frequency estimates. * Charts of the seasonal distribution of annual maxima * Probabilistic temporal distributions for 6-hour, 12-hour, 24-hour, and 96-hour durations in both chart and digital form * Rainfall frequency estimates with corresponding upper and lower bounds of 90% confidence intervals will be available at 30-arc sec grid for durations of 1, 2, 3, 6, 12 and 24 hours. |