

2024 Pollutant Load Estimation Tool (PLET) Precipitation Data Update

This document presents the 2024 updates made to the precipitation data for the PLET model. The document outlines the data provided by EPA and discusses the approach for updating the PLET precipitation data.

Existing PLET Precipitation Data

The existing spatial coverage of the precipitation stations consists of approximately 5,000 weather stations across the contiguous United States, including HI, AK, and Puerto Rico. The data included National Oceanographic and Atmospheric Administration National Climate Data Center (NOAA-NCDC) weather stations with at least 30 years of data (USEPA 2019). The period of record varied by station with the most recent data being from 2009. Figure 1 shows the spatial coverage of the existing precipitation stations in PLET.

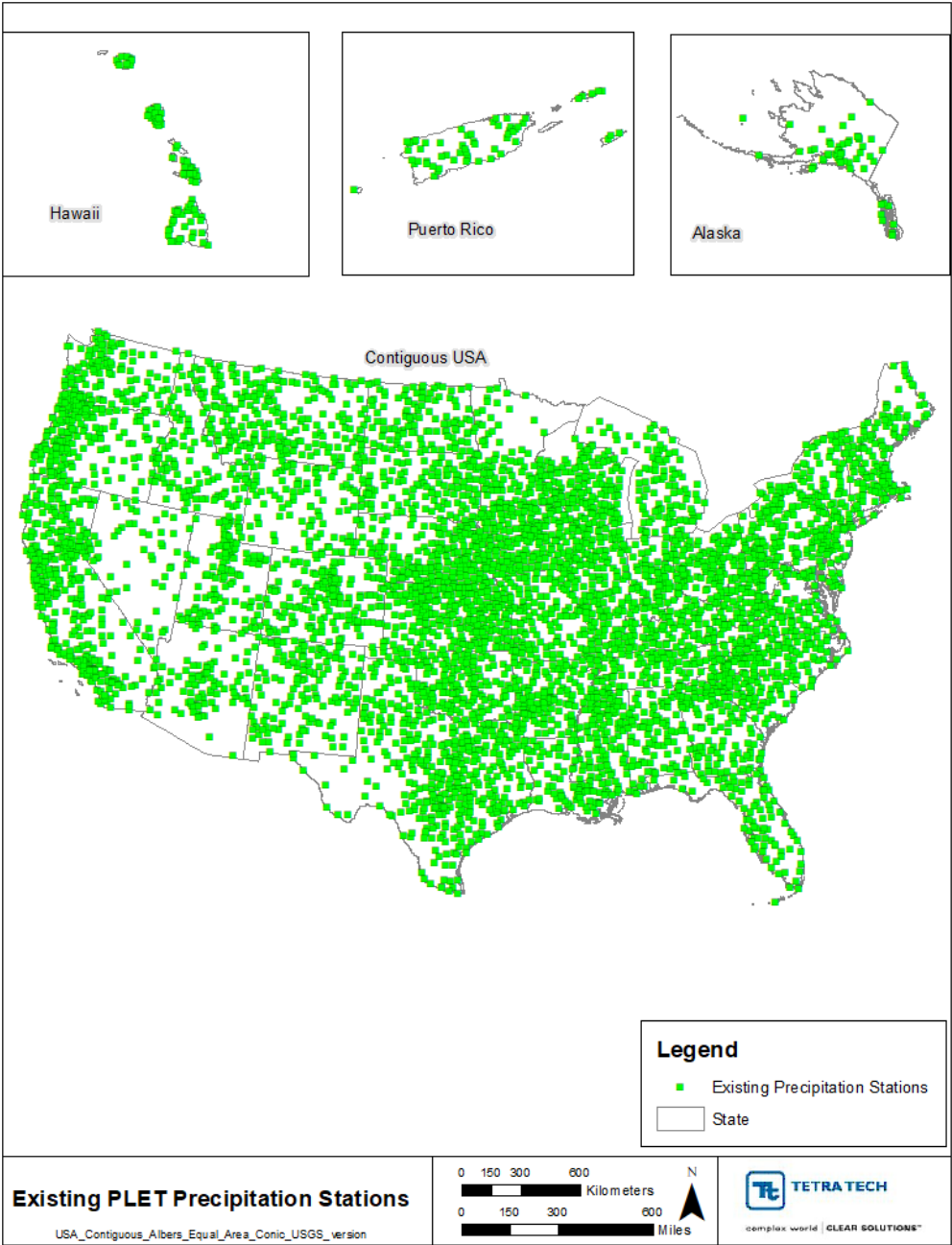


Figure 1. Existing PLET precipitation stations (NCDC-NOAA data) (Used in PLET March 2022 – June 2024)

June 2024 Update to PLET Using HAWQS-PRISM Precipitation Data

The Parameter-elevation Regression on Independent Slopes Model (PRISM) model couples point observations of climate data with a digital elevation model to generate daily, monthly, and annual normals of climate data including precipitation. The PRISM data are available at a 2.5 arcmin (4 km) grid resolution across the contiguous United States. Texas A&M University (TAMU), which supports EPA's Water Economic Center (WEC) with the EPA Hydrologic and Water Quality System (HAWQS) model, used the daily PRISM data available at each 4 km x 4 km grid cell and created an area-weighted dataset at the hydrologic unit code 14 (HUC14) scale, served at the centroid location of each HUC14 watershed. EPA obtained a processed PRISM weather dataset derived from the HAWQS model from TAMU. These data were used to update the spatial and temporal coverage of precipitation data in the PLET model.

The size of a HUC14 watershed is approximately 8 square miles (mi²) compared to a HUC12 watershed, which is approximately 38 mi². The dataset included precipitation data at 352,631 HUC14 centroid locations (referred to as stations in the document from here onwards). Since the HAWQS stations corresponded to the centroid of the HUC14 scale watersheds, the new dataset provided more stations within each HUC12 that can now be used within PLET. This corresponds to a two-order-of-magnitude increase in the total number of stations compared to the number of existing stations within PLET.

The HAWQS precipitation files were provided in the Soil and Water Assessment Tool (SWAT) input file format (pcp input file). In the SWAT model, the amount of precipitation is specified in millimeters (mm). The format includes the date in the first row, followed by daily precipitation values. No time stamps are included in the data file since daily precipitation is implied by the model.

The HAWQS data provided a long-term 42-year period of record, 1981 through 2022, and extended to more recent years relative to the existing NOAA-NCDC weather dataset. Based on the assumptions used in the previous round of weather updates, a 30-yr period from 1993 to 2022 was used to reflect long-term conditions in the PLET model.

Data Processing

Each individual SWAT pcp daily time series file was processed for the period of record from 1993 to 2022. This involved reading each input file, assigning a time stamp, and filtering out the desired period of record. Next, the data were processed to calculate correction factors from daily precipitation time series and the number of rain days. For calculation purposes, a rain day was considered an event when the rainfall was greater than 5mm/day. For each year, the total annual rainfall greater than 5mm/day was calculated along with the mean annual precipitation. This was used to calculate the percentage of rainfall events that exceeded 5mm. Similarly, the number of days in a year when the rainfall was greater than 5mm/day was also calculated, which was then used to calculate the percentage of rain days that generate runoff as a rain day correction factor. The details are also outlined in Appendix C – Section 2 of the PLET User's Manual (USEPA 2022). Tetra Tech developed a python script to create a consistent and efficient workflow for the data processing and calculations associated with the high volume of input data. Following completion of the data processing, Tetra Tech processed a few stations individually in a spreadsheet to provide quality assurance that the results and calculations were correct and test the assumption that all input files were identical.

TAMU also provided individual data station latitude and longitude as a separate csv file (huc14-2024-03-27-101511.csv). This information was assigned to each of the stations. Because the original weather data in PLET were associated by county, Tetra Tech conducted a GIS analysis to identify each of the HUC14 station centroid locations that fall within each state/county in the country. In addition, the GIS analysis also identified and assigned the HUC12 watershed number for each of the individual stations.

Upon completion of the GIS processing, the data were again checked to ensure all data were captured and each station location was assigned a latitude, longitude, county name, Federal Information Processing Standards (FIPS) code, and HUC12 number. The quality check revealed that there were HUC14 stations located outside of the United States and did not have a state or county associated with them. In addition, several stations in coastal areas had locations on water, outside of any HUC12 watersheds. These represented a total of 1,276 stations (1,211 stations outside the United States plus 65 stations with no HUC12) out of the total 352,631 stations. These 1,276 stations were excluded from the final dataset. Given the station density, removing these stations did not

have a significant impact on the data resolution. The final count of the total number of stations included in PLET is 351,355 stations. Figure 2 shows the location of all the stations, along with the stations that were excluded from the PLET precipitation dataset.

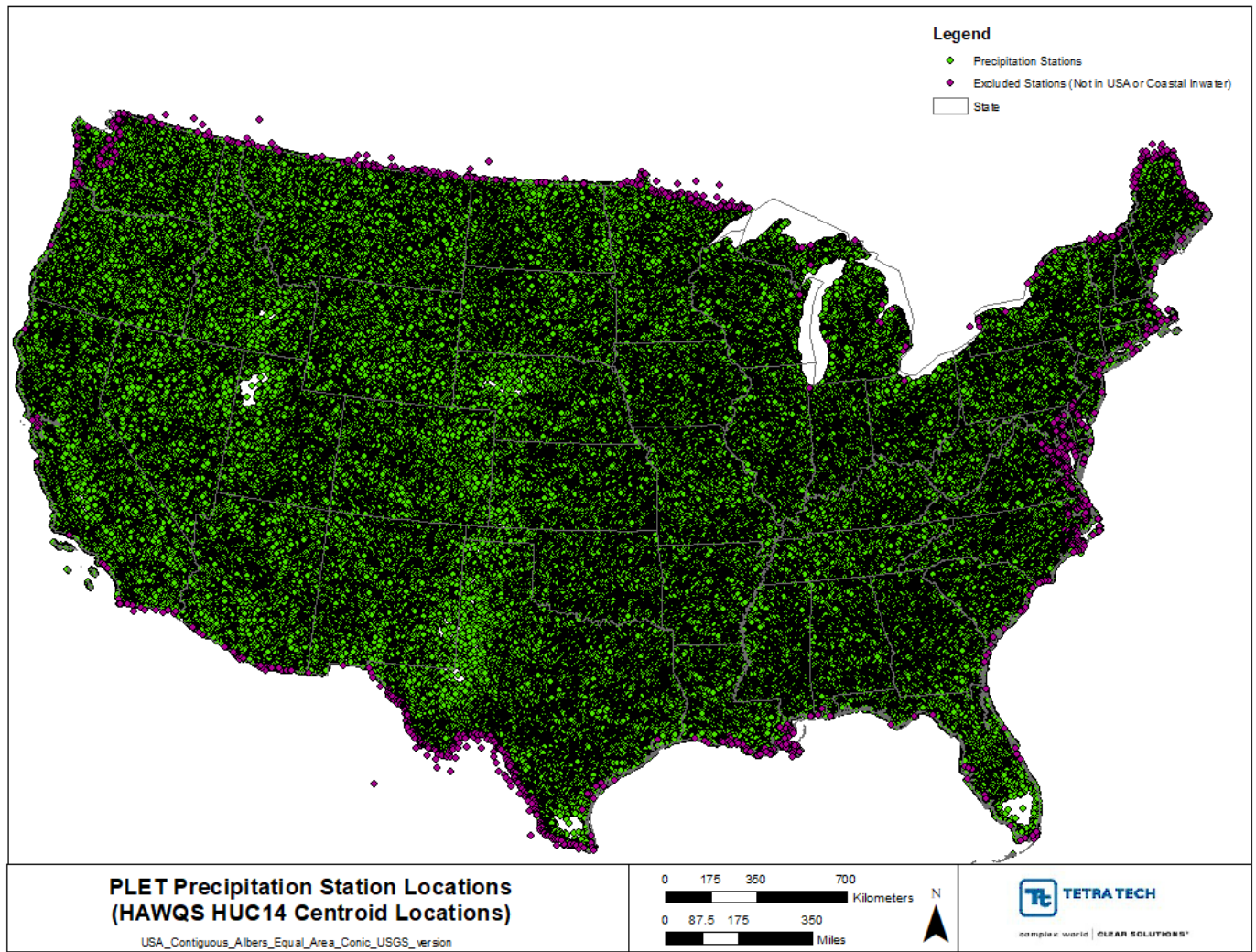


Figure 2. PLET precipitation stations from HAWQS PRISM data at HUC14 centroid (Implemented June 2024)

County-wide average data for each of the rainfall related parameters were also calculated to be consistent with the NOAA-NCDC PLET precipitation input dataset, which included county averages. While county-wide averages are not included in the PLET model, the data for all the stations falling within a particular county were averaged and presented along with the processed dataset to be available for reference.

The final output was an Excel spreadsheet with a table that included each station location and its associated data. The table included the following relevant fields:

- Latitude,
- Longitude,
- State Name,
- County Name,
- County FIPS code,
- HUC12,
- HUC14,

- Station Elevation (m) (not used by PLET but captured for information purposes, as part of the data collection process),
- Annual Average Precipitation (inches),
- Annual Average Rain Days,
- Rainfall Correction Factor, and
- Rain Day Correction Factor

The county-wide average values for each state are provided in a separate tab in the Excel spreadsheet.

The HAWQS data are not available for Alaska, Hawaii, or Puerto Rico/US Virgin Islands. For these jurisdictions, the individual NOAA-NCDC weather station precipitation data were retained from the original PLET weather dataset, latitude and longitude information were added, and these data were appended to the new precipitation dataset to ensure complete coverage of all states and Puerto Rico. Specifically, a total of 173 additional stations from Alaska, Hawaii, Puerto Rico, US Virgin Islands were added to the data for the 351,355 stations in the contiguous United States.

References

HAWQS 2.0. 2023. "HAWQS System 2.0 and Data to model the lower 48 conterminous U.S using the SWAT model". doi.org/10.18738/T8/GDOPBA. Texas Data Repository, V2

USEPA. 2019. BASINS 4.5 (Better Assessment Science Integrating point & Non-point Sources) Modeling Framework. National Exposure Research Laboratory, RTP, North Carolina.
https://www.epa.gov/system/files/documents/2022-02/basins4.5coremanual.2019.03_partial_508c.pdf

USEPA. 2022. Pollutant Load Estimation Tool (PLET) Version 1. – User's Guide. Prepared by Tetra Tech. March 2022. https://www.epa.gov/system/files/documents/2022-04/user-guide-final-04-18-22_508.pdf