Indicator Reference Sheet – March 6, 2022

100-Year Flood Zone

U.S. Environmental Protection Agency

Indicator Name

- *% 100-Year Flood Zone in Watershed (WS)*

Indicator Category | **Stressor**

Subcategory | *Flood Inundation Risk*

Available in RPS Tool files for all lower 48 states

Indicator Description

Background

The term *100-year flood* describes a flood magnitude that has a one percent chance of occurring each year. [1] These floods can cause significant damage to ecosystems and human structures.[1] The *100-year flood zone* consists of areas that are at-risk for becoming inundated with water during a 100-year flood.[1] These zones occur in low-lying areas, along rivers, lakes, and coastlines, or in other areas with poor drainage. The 100-year flood zone is used for flood risk mapping by the Federal Emergency Management Agency (FEMA) and the National Flood Insurance Program.[1] Factors used to map a 100-year flood zone include elevation and topography, proximity to water bodies, rainfall and storm surge patterns, soil drainage, and human development.[2]

What the Indicator Measures

This indicator measures the extent of the 100-year flood zone in a HUC12 subwatershed (Figure 1):[*]

- ***% 100-Year Flood Zone in Watershed (WS)*** – area of the 100-year flood zone in the HUC12, expressed as a percentage of total HUC12 area. As part of indicator data processing, waterbodies were excluded from the 100-year flood zone. The indicator therefore only reflects the *land* area in the 100-year flood zone.

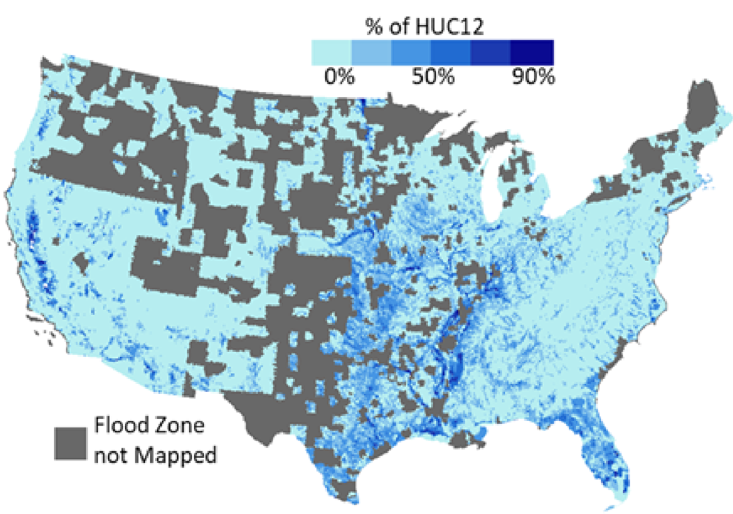

*Figure 1. Map of **% 100-Year Flood Zone in Watershed** for HUC12s in the contiguous US.*

Relevance to Water Quality Restoration and Protection

Flooding can have both positive and negative effects on aquatic ecosystems depending on flood magnitude, duration, and frequency. For instance, while floods can replenish nutrient and groundwater levels in floodplains and revitalize wetlands,[3] they can also have detrimental impacts to watersheds.[3] During floods, water picks up chemical contaminants, soil particles, and other debris from the landscape and transports them into nearby waterbodies where they can be harmful to the health of humans and aquatic organisms.[3] In addition to causing damage to property and infrastructure, severe floods can also disturb, and sometimes destroy, important aquatic habitats through erosion of river channels[3] or shorelines.

A study of flooding impacts on aquatic ecosystem services found that losses in aquatic life, recreation, and tourism consistently occurred with severe floods (100-year or greater magnitude).[3] Flooding can also harm human health. For instance, in 2018, extreme flooding in central Texas from the Llano River caused abnormal amounts of dirt, silt, and debris to wash into downstream reservoirs that provide drinking water to the City of Austin. This hindered water treatment capacity and led to a mandate for residents to boil water.[4]

Severe floods have the potential to become more common in the US due to altered precipitation patterns and other effects of climate change.[5] For example, a recent study projected that historical "100-year flood" magnitudes could occur as frequently as every 1 to 30 years along the US Atlantic and Gulf Coasts by 2100 due to increasing rainfall from tropical storms and sea level rise.[6] Severe flooding impacts may also be more pronounced in areas with high levels of impervious cover and exposed soils (e.g., construction sites, tilled cropland, etc.), or where wetlands and floodplains, which naturally store floodwaters, have been diminished due to human development.[7,8]

This indicator can be used to identify HUC12s that may be at greater risk for severe flooding and could be considered priorities for follow-up resilience planning and management. Additional indicators, such as the percentage of impervious cover or recent trends in developed land uses, can also be included in an evaluation

[*] HUC12s are subwatershed delineations in the National Watershed Boundary Dataset. HUC12s are referenced by their 12-digit Hydrologic Unit Code.

of priority HUC12s to gain a more complete picture of the vulnerability of watersheds to flooding impacts.

Processing Method

This indicator was derived from flood zone maps maintained by FEMA in the National Flood Hazard Layer database. A map layer of the 100-year flood zone in the conterminous US was acquired from the National Flood Hazard Layer database in February 2021.

The 100-year flood zone map layer was overlaid with HUC12 boundaries, surface water features in the medium-resolution National Hydrography Dataset, and surface water areas in the 2016 National Land Cover Database (Figure 2). Together, these datasets were used to calculate the area of land in the 100-year flood zone per HUC12 (note that lakes, rivers, and other waterbodies were not counted when calculating the flood zone area per HUC12). The flood zone area was then converted to a percentage of the total HUC12 area.

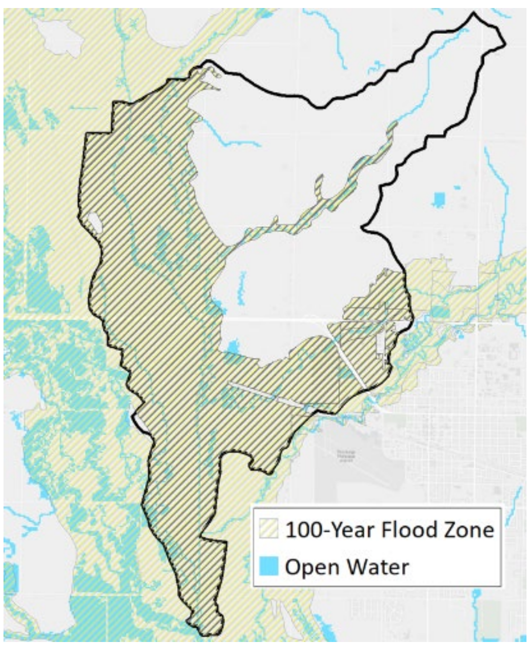

Figure 2. Overlay map of the flood zone, open water, and HUC12 boundaries for an example HUC12.

Limitations

- Flood zone maps are regularly updated by counties and local governments. The values of this indicator reflect a February 2021 snapshot of flood zone maps.
- 100-year flood magnitude is determined through statistical analysis of historical data and does not account for factors such as sea level rise, climate change, and land development that may impact the frequency of flooding.
- The flood zone maps maintained by FEMA do not map the 100-year flood zone in rural areas with very low human populations. HUC12s were assigned blank values of this indicator if the 100-year flood zone was unmapped for more than 50% of the HUC12.

Links to Access Data and Additional Information

HUC12 indicator data can be accessed within Recovery Potential Screening (RPS) Tool files, available for download from the EPA RPS website.

Indicator data are also available for download or as web services on the EPA Watershed Index Online (WSIO) website.

The FEMA National Flood Hazard Layer database used to calculate this indicator can be accessed from the FEMA National Flood Hazard Layer Viewer.

References

[1]FEMA. 2005. Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials. FEMA 480.

[2]FEMA. 2019. Guidance for Flood Risk Analysis and Mapping, Hydrology: Rainfall-Runoff Analysis.

[3]Talbot, C., et al. 2018. The impact of flooding on aquatic ecosystem services. *Biogeochemistry.* 141: 439–461.

[4]Anchondo, C. 2018. Austin issues city-wide boil water notice; calls for action "to avoid running out of water". *The Texas Tribune*.

[5]Milly, P., et al. 2008. Stationarity is dead: Whither water management?. *Science.* 319(5863): 573-574.

[6]Marsooli, R., et al. 2019. Climate change exacerbates hurricane flood hazards along US Atlantic and Gulf Coasts in spatially varying patterns. *Nature Communications*. 10: 3785.

[7]Brody, S., et al. 2007. Identifying the impact of the built environment on flood damage in Texas. *Disasters*. 32(1): 1-18.

[8]Brody, S., et al. 2013. Open Space Protection and Flood Mitigation: A National Study. *Land use policy*. 32: 89-95.