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The 3D Elevation Program (3DEP) and Its Role in Mapping Hazards and Resources

In 2021, Congress passed two laws establishing and directing the 3-dimensional Elevation Program (3D Elevation Program, or 3DEP) to support identification of hazards and resources, among other purposes: (1) the National Landslide Preparedness Act (NLPA; P.L. 116-323) and (2) the Infrastructure Investment and Jobs Act (IIJA; §40201 of P.L. 117-58; 43 U.S.C. §31l). The NLPA directed the Secretary of the Interior, acting through the Director of the U.S. Geological Survey (USGS), to establish 3DEP (43 U.S.C. §3104) to "provide 3D elevation data for the United States"; produce standard, publicly accessible 3D data; and coordinate, facilitate, and promote the collection, dissemination, and use of 3D elevation data and data products among federal and nonfederal entities. Lidar (light detection and ranging) is a technology used to acquire high-resolution models of ground elevation with a vertical accuracy of 10 centimeters (4 inches). 3DEP acquires nationwide 3D elevation data using lidar and other methods. NLPA authorized $40 million annually from FY2021 to FY2024 for the USGS to carry out 3DEP. The act also established a National Landslide Hazards Reduction Program to identify, map, assess, and research landslide hazards.

P.L. 117-58 established the Earth Mapping Resources Initiative (Earth MRI) and required Earth MRI to integrate 3DEP data with other USGS mapping programs. The IIJA provided $320 million for Earth MRI to accelerate the USGS's resources and mapping mission while prioritizing finding critical mineral resources. P.L. 117-169 (commonly known as the Inflation Reduction Act of 2022, or IRA) provided an additional $23.5 million in funding for 3DEP to remain available until September 30, 2031.

3D Elevation Program

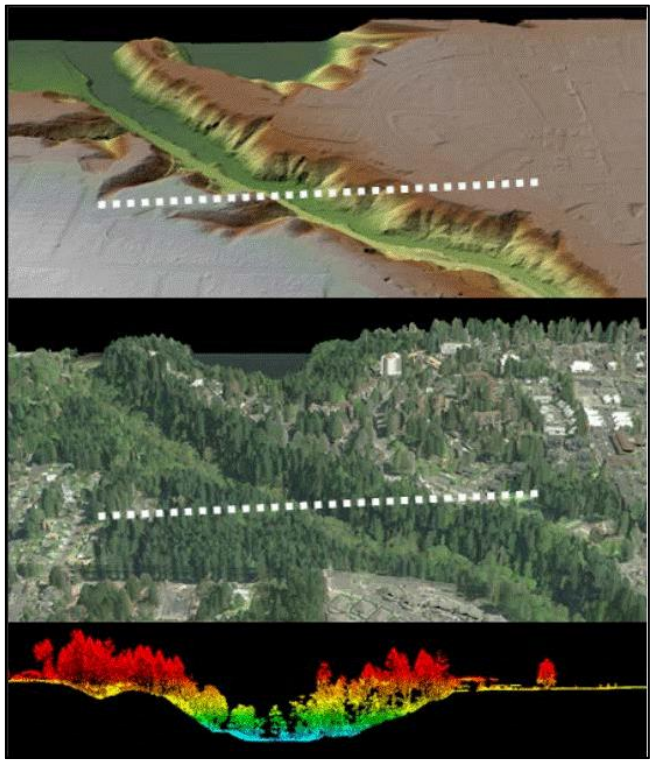
According to the USGS, the goal of 3DEP is to "provide the first-ever national baseline of consistent high-resolution topographic elevation data, including both the bare Earth surface and 3D point clouds that map the Nation's natural and constructed features."

Lidar

The lidar data assist in identifying natural hazards; engineered structures; energy, mineral, and water resources; and vegetative cover. Lidar data increase the spatial precision of geologic mapping to more accurately define the surface extent of a deposit and may help identify other structures, such as faults or folds, that may impact the model of the subsurface extent of a mineral deposit or a natural hazard feature. According to the USGS, 3DEP may have annual benefits of $7.9 billion for resources, hazards, and infrastructure plus flood and coastal risk management; agricultural and land management; and security, safety, and disaster response; among other benefits.

Lidar data are collected as a *point cloud* of individual points reflected from everything on the surface at different elevations (**Figure 1**). Airborne lidar consists of a laser scanner mounted on an aircraft that transmits light pulses to the surface. The light pulses are reflected back from various points on the surface, and the pulses' travel times are used to calculate the distances between the scanner and the points to determine elevation. From these data, the USGS produces a bare earth Digital Elevation Model (DEM) by removing any points from structures and vegetation. The USGS is replacing legacy DEMs with lidar DEMs.

Figure 1. Examples of Lidar Bare Earth and Point Cloud Data, Region in Olympia, WA



Source: Vicki Lukas and Vanessa Baez, *3D Elevation Program—Federal Best Practices*, USGS, USGS Fact Sheet 2020-3062, 2020.

Notes: Top: bare earth digital elevation model from lidar (color shading shows elevation from low [green shades] to high [brown shades]) for a region in Olympia, WA. Middle: colorized point cloud data of the same region as the top (colors are estimated based on what a person might see in this region). Bottom: lidar point cloud profile of the vegetation (color shading shows elevation from low [blue shades] to high [red shades]) along the white dotted line shown

in the upper images. A bare earth lidar model removes any structures or vegetation to show the bare earth topography (top).

Alaska IfSAR

The USGS, with partners, collected airborne interferometric synthetic aperture radar (IfSAR) data for Alaska through an Alaska Mapping Initiative and completed a state map in 2020. According to the USGS, the Alaska IfSAR acquisition supports 3DEP, and the IfSAR technology was used because it can penetrate the clouds, smoke, and haze often present in Alaska. IfSAR sends out pulses of high-frequency electromagnetic waves that are unaffected by darkness, clouds, or other weather conditions. The radar strikes the terrain at oblique angles, which accentuates landscape details. The vertical resolution ranges from 0.625 meters (2 feet) to 2.5 meters (8 feet). The USGS, with partners, has collected or is in the process of collecting some lidar data in some areas of Alaska.

Status of 3DEP Mapping

The USGS aims to complete a national 3DEP map by 2027. The 3DEP data contributes information to the USGS National Map, which is a suite of products, services, and applications to access geospatial information about the nation's topography, natural landscape, and built environment. An earthquake, landslide, flood, or other event may change the landscape, and the USGS may reacquire new lidar DEMs where possible.

The USGS and the National Oceanic and Atmospheric Administration in 2022 published a *3D Nation Elevation Requirements and Benefits Study* to document national requirements for improved topographic and bathymetric elevation data, estimate the benefits and costs of meeting these requirements, and evaluate multiple national 3DEP implementation scenarios for the next generation of 3DEP.

Integration of 3DEP into Other USGS Mapping Initiatives

Earth Mapping Resources Initiative

Earth MRI is mapping the nation's resources with 3DEP data, geochemical and geophysical data, and other data. From 2019 to 2023, Earth MRI has partnered with 40 states and territories, tripled the national coverage of geophysical surveys, provided $21.9 million to state agencies, and spent $129 million to acquire data.

3D Hydrography

The USGS is systematically remapping the nation's hydrography using 3DEP and Alaska IfSAR data integrated with inland bathymetry (green wavelength lidar to measure bathymetry through water) and has established the 3D Hydrography Program for hydrography map products. The maps show the 3D elevation of lakes, streams, catchments, drainage areas, and other hydrologic features.

Coastal Mapping

The USGS partners with other federal agencies to collect simultaneous topographic and bathymetric lidar data as part of coastal mapping initiatives.

3D National Topography Model

The USGS aims to integrate 3DEP data with 3D Hydrography Program data to develop a 3D National Topography Model (3DNTM). 3DNTM fulfills the statutory requirements of NLPA and the Geospatial Act of 2018 (P.L. 115-254, 43 U.S.C. §§2801-2811). The Geospatial Act requires the USGS and other federal agencies to collect, maintain, disseminate, and preserve geospatial data and to coordinate geospatial data activities.

Congressional Considerations

Potential subjects of congressional interest could include the status of 3DEP, the integration of 3DEP into other mapping initiatives, and how the 3DEP program meets congressional goals for hazard risk reduction and resource identification. In addition, Congress may consider how 3DEP data are acquired, maintained, disseminated, and preserved in accordance with NLPA and the Geospatial Act. The authorization of appropriations for 3DEP expired in FY2024. Some bills introduced in the 119th Congress (S. 1626, H.R. 2250, and H.R. 3816) would reauthorize appropriations for 3DEP. Some funds appropriated for 3DEP by IRA remain available, and the FY2026 budget request calls for $3 million from IRA for 3DEP.

The FY2026 budget request also calls for the USGS to focus on domestic energy and mineral dominance. To support energy and mineral resource identification, the request would reorganize some geologic data and mapping activities with some energy and mineral activities into a new USGS Geology, Energy, and Minerals Mission Area. The request does not specify whether 3DEP would move from the Core Science Systems Mission Area, where 3DEP is currently organized in the National Geospatial Program. The effect of any USGS reorganization on 3DEP could be of congressional interest.

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