Chesapeake Community Research Symposium 2026

Session 11: Geospatial Targeting of Restoration and Conservation Actions

Session Leads: Peter Claggett & John Wolf

I. High-Resolution Geospatial Data and Technical Advances

Labeeb Ahmed (US Geological Survey)

Seamless Elevation Data in the Chesapeake Bay watershed

Elevation is foundational data, essential for understanding processes such as water flow, sediment transport, habitat connectivity, and floodplain dynamics, which are high profile topics that guide restoration and conservation actions in the Chesapeake Bay watershed. Despite its importance, seamless digital elevation models (DEMs) are rare, especially across large geographies like the Chesapeake, due to challenges posed by massive data volumes, varying spatial resolutions, multiple projection systems, measurement units, and irregular temporal coverage. These factors make acquiring, standardizing, and reconciling large datasets difficult. Furthermore, these challenges create significant barriers for projects with limited funding, tight timelines, insufficient technical capacity, or the need to scale the analysis upstream or downstream. As a result, users are often forced to rely on coarser resolutions (3 to 30 meters) collection between approximately 1923 to 2015/2020 (depending on resolution), which compromises the precision and accuracy of spatial analyses and downstream modeling. This session introduces the Seamless Elevation Database—a unified one-meter DEM in the Chesapeake Bay watershed and Delaware River basin. The database addresses critical data gaps by making seamless DEMs readily available to stakeholders without requiring significant resource commitments. These DEMs are produced by harmonizing roughly 70 LiDAR-derived datasets to create a ‘best-available’ snapshot based on LiDAR quality levels and collection years and include topo-bathymetry where available. This standardized, high-resolution framework is actively being incorporated into applications such as mapping channels and floodplain geomorphometry, delineating riparian zones, assessing hydrologic connectivity, and conducting before-and-after assessment of stream restoration. In addition, new metrics and measures of geomorphic change are being explored and developed to complement existing high-resolution data products, supporting restoration and conservation activities throughout the Chesapeake Bay watershed.

Michelle Katoski (U.S. Geological Survey), Peter Claggett, Joseph Delesantro, Andrew Sekellick

Characterizing hydrologic connectivity for water quality modeling and BMP targeting in the Chesapeake Bay Watershed

Hydrologic connectivity substantially affects sediment and nutrient transport and is therefore a key consideration for both water quality modeling and strategic targeting of Best Management Practices (BMPs). We present a suite of watershed characteristics for the Chesapeake Bay Watershed that quantify multiple dimensions of hydrologic connectivity, including the Index of Connectivity (Borselli et al., 2008), topographic wetness index, Euclidean and flow-path distances to streams, and indicators of infiltration excess ("blue-spots"). These watershed characteristics provide a standardized, multi-scale framework for linking landscape structure, hydrologic connectivity, and contaminant delivery. We will first present how these datasets are currently applied within regional water quality models, including CalCAST. We will then demonstrate preliminary, qualitative examples illustrating how connectivity-based metrics may be used in exploratory analyses to support BMP targeting and prioritization, such as identifying cropland areas where hydrologic connectivity suggests more direct delivery of nutrients to streams. While these BMP-targeting applications are under development, they highlight the potential of connectivity-informed watershed metrics to complement existing modeling frameworks and inform future management strategies across the Chesapeake Bay Watershed.

Jackie Pickford (U.S. Geological Survey)

Mapping Sewer Service Areas and Septic Systems to Inform Management Decisions

High-resolution geospatial data and emerging technologies have the potential to transform how we identify and prioritize restoration actions in the Chesapeake Bay watershed. This presentation will introduce the first comprehensive parcel-level mapping of sewered areas and individual septic systems across the entire Chesapeake Bay watershed using tax parcel data. These data enable more precise identification of areas where wastewater infrastructure upgrades (e.g., Enhanced Nutrient Removal) and maintenance (e.g., routine septic pumping), and new sewer connections may yield significant water quality and ecological benefits. This presentation will also include examples of how managers can use this information to identify and prioritize septic systems at risk of polluting nearby waterways to optimize investments and accelerate progress toward watershed restoration goals.

Sarah McDonald (U.S. Geological Survey)

Four Decades of Land Use Change in the Chesapeake Bay Watershed: Integrating High Spatial and Temporal Resolution Datasets

Landscape monitoring and management is foundational to tracking and achieving many of the 2025 Chesapeake Bay Watershed Agreement goals, including healthy landscapes and clean water. With the increased availability of satellite and aerial imagery, many representations of the landscape have been developed by numerous sources via land cover and land use maps. High-resolution datasets (1-meter) continue to be proven necessary for making informed management decisions (e.g., placement of Best Management Practices). Coarser resolution datasets (30-meter) generally lack spatial precision and categorical resolution found in high-resolution products but contain a temporal depth that does not exist for high-resolution products. The spatial resolution of high-resolution datasets has not been combined with the temporal depth of coarser datasets. In the Chesapeake Bay watershed, 1-meter resolution, 56-class Land Use/Land Cover for 2013/14, 2017/18, and 2021/22, offer the highest spatial and categorical resolution available. The Annual National Land Cover Database (NLCD) includes 16-class land cover and percent impervious for 1985–2024, offering the longest temporal record of land cover and imperviousness. In addition, TerraPulse, Inc. developed annual percent tree canopy from 1985–2025, offering the longest temporal record of tree canopy. This presentation describes how the high spatial and categorical resolution of the 1-meter data were combined with the high-temporal resolution of the NLCD and TerraPulse tree canopy to derive a historical land use database for informing the Phase 7 watershed model. The presentation will compare land use trends across the watershed, such as rates of forest and agriculture conversion to development, agriculture conversion to forest, and timber harvest rotation. The presentation will conclude with a discussion of how land use histories relate to conservation and restoration efforts and the nutrient loads we see today.

Peter Claggett (U.S. Geological Survey)

Simulating future development in the Chesapeake Bay Watershed

The Chesapeake Bay Land Change Model (CBLCM) is an open-source pseudo cellular automata land change model that simulates infill and redevelopment, residential and commercial growth, natural and agricultural land conversion, and development served by sewer or septic wastewater treatment systems. The CBLCM is distinct among land

change models in its ability to represent multiple types of development while explicitly accounting for infill and redevelopment dynamics. The CBLCM has been used to assess the vulnerability of farmland and forests to future development and to evaluate the pollution increases affecting the Chesapeake Bay that can be avoided through land use planning and conservation efforts. More recently, the model has been updated and enhanced by leveraging tax parcel data, 1-meter resolution land use/land cover data, and information from the 2020 Decennial Census of Population and Housing. These data enhancements provide a more accurate representation of lands suitable for growth, residential and commercial land uses and densities, infill and redevelopment, and impervious surfaces. This presentation will review and discuss results from the latest simulation covering the period from 2025 to 2075 and will place these projections in the context of observed past and present changes in land use and emerging issues.

Amy Freitag (NOAA NCCOS), Katherine Auerswald, Seann Regan

A Community Risk Assessment of Flooding and Heat Hazards in the Baltimore Metropolitan Area

Coastal communities in the Baltimore Metropolitan Area face increasing, multi-faceted environmental hazards from storm surge, sea level rise, stormwater flooding, and urban heat. This geospatial assessment addresses the need for a mid-scale analysis to support community adaptation planning. We developed indices to assess population metrics, structural exposure, and ecosystem service valuation. We then layered these with hazard indices of stormwater flooding, sea level rise, storm surge, and urban heat. Geospatial layering techniques like bivariate choropleth mapping help visualize areas of risk co-occurrence. These areas are more likely to face compounding and cascading effects of environmental hazards. More detailed analysis of these key areas shows where interventions such as tree planting or waterfront nature-based infrastructure may help mitigate risk.

II. Audience-Driven Design for Conservation and Restoration Tools, Maps, and Data

Sophie Waterman (USGS)

Turning User Insights into Action: Redesigning Geospatial Tools for Conservation and Restoration

As the Chesapeake Bay Program prepares for the Beyond 2025 framework, there is a growing need to more effectively target conservation and restoration actions, prioritize

resources, and communicate outcomes in ways that support local decision making. To address these needs, the CBP Geospatial Science and Applications Team conducted user research in Spring 2025 to better understand how diverse stakeholders use geospatial decision support tools and what improvements are needed to increase their effectiveness. Interviews confirmed that geospatial data is central to identifying priorities, planning and implementing projects, and tracking outcomes. Participants emphasized the importance of high resolution, parcel level data for local action alongside continued data aggregation across reporting units. This session highlights how these user insights are informing a user centered redesign of the portal.

John Wolf (U.S. Geological Survey)

Modernizing the Chesapeake Targeting Portal: Aligning Data, Maps, Tools, and Outcomes through User-Driven Feedback

Effective conservation and restoration efforts in the Chesapeake Bay watershed require seamless access to high-quality geospatial data, interactive maps, and decision-support tools tailored to stakeholders' needs. The Chesapeake Targeting Portal 2.0 initiative responds by reinventing the original portal and incorporating insights from the Chesapeake Bay Program's User Research Project and feedback from Version 1 users. The redesigned portal will feature curated galleries of targeting maps, decision-support tools, datasets, and use cases aligned with Chesapeake Bay Watershed Agreement goals.

Zhaoying Wei (UMCES)

Designing Outcome-Centered Interactive Maps for the Chesapeake Targeting Portal 2.0

Interactive maps are being designed to support conservation and restoration planning across the Chesapeake Bay watershed through alignment with the 21 Outcomes of the 2025 Chesapeake Bay Watershed Agreement. Each targeting map is linked to one or more outcomes and built from curated spatial layers recommended by Chesapeake Bay Program Workgroups. Cartographic standards and usability findings guide map design so that maps remain intuitive, consistent, and actionable for practitioners.

Andrew Fitch (US Geological Survey), Catherine Krikstan

Building With, Not For: Developing ChesapeakeData Through Audience Engagement

ChesapeakeData is a Chesapeake Bay Program website created to simplify the discovery and dissemination of data and web applications used by CBP and its partners. Development was guided by audience engagement exercises such as card sorting and user testing to better understand how partnership members search for data and applications. These insights helped shape a more effective discovery tool.

Alex Gunnerson (Chesapeake Bay Program Office Contractor Koniag Government Services)

Integrating User Research Principles into Phase 7 Watershed Model Planning Tools

Watershed model planning tools such as the Chesapeake Assessment Scenario Tool (CAST) support the development and tracking of Watershed Implementation Plans. This presentation discusses user research conducted to understand the motivations and needs of watershed planners and water quality managers. Findings highlight commonly used features, desired functionality, and interface preferences, as well as how stakeholders envision using remote sensing to support BMP verification.

III. Stakeholder-Driven Targeting Applications

Rebecca K. Ransom (U.S. Geological Survey), John Wolf

Lower Mississippi-Gulf Water Science Center Geographic Targeting and Source Water Protection

The Chesapeake Bay watershed faces the dual challenge of restoring ecological health while safeguarding drinking water supplies. This presentation introduces a geospatial workflow that overlays Source Water Protection Areas with Chesapeake Bay Watershed Agreement Outcomes. Using bivariate mapping within an interactive geonarrative, the analysis identifies upstream landscapes where protecting source waters can simultaneously reduce nutrient and sediment loads, sustain aquatic habitat, and improve resilience for downstream communities.

Coral Howe (U.S. Geological Survey)

Toward a Capacity-Informed Targeting Framework for Chesapeake Bay Restoration

This study explores how the Rural Capacity Index can inform Chesapeake Bay Program decision-making by accounting for local institutional and financial capacity. Capacity metrics were translated to NHDPlus catchments and combined with Chesapeake Healthy Watersheds Assessment metrics to develop a framework that groups catchments into Restoration Gaps, Innovation Hubs, Preventive Protection areas, and Targeted Investment zones.

David Strong (US Geological Survey), John Wolf

Recognizing Organizational Service Areas to Strengthen Geospatial Targeting in Sentinel Landscapes

This presentation describes a web-based GIS application that maps the service areas of watershed organizations and land trusts across the Chesapeake Bay watershed, focusing on the Department of Defense–designated Sentinel Landscapes. The ArcGIS Dashboard allows users to visualize stewardship coverage, identify overlaps, and locate potential partners for conservation initiatives.

Michael Evans (Chesapeake Conservancy), David Saavedra

Automatically identifying wetland conservation and restoration opportunities with AI

RCI data are available at county and subdivision levels, but CBP tools use hydrologic scales. Area-weighted interpolation was used to convert capacity metrics into NHDPlus catchments. Combining these capacity scores with Chesapeake Healthy Watersheds Assessment metrics produced a system to guide restoration and conservation strategies.

Rosemary Fanelli (U.S. Geological Survey)

Taking the pulse of Chesapeake Bay Watershed stream ecosystems: A synthesis of observational data for six indicators of freshwater stream health, 2018–2023

The USGS compiled observational data from 2018–2023 for six indicators of stream health, including fish and benthic macroinvertebrate communities and abiotic stressors such as streamflow, temperature, salinity, nutrients and sediment, and physical habitat. Analyses identified spatial patterns, summarized results by subbasin, and highlighted

monitoring gaps. Results show elevated stressor conditions and poorer biological communities in urban and agricultural settings, especially near major metropolitan areas.