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Testimony on the importance of Great Lakes mapping

House Committee on Natural Resources
Subcommittee on Water, Wildlife and Fisheries
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Chairman Bentz, Ranking Member Huffman and Members of the Committee, thank you for inviting me to testify in support of H.R. 7020, the Great Lakes Mapping Act, and giving me the opportunity to highlight how this bill is critical to the people, economy, and ecosystems in our region.

I am Jennifer Boehme, Chief Executive Officer of the Great Lakes Observing System (GLOS), a Michigan based non-profit organization that provides high-quality lake information in support of science, policy, management, and industry in the Great Lakes region.

GLOS is one of 11 Regional Associations that are part of the Integrated Ocean Observing System (IOOS), a network of non-federal organizations that collect data and transform it into useful tools tailored to local needs through public-private partnership. IOOS is funded through the National Oceanic and Atmospheric Administration (NOAA), and RAs like GLOS leverage those dollars to do even more for our communities.

GLOS provides data such as weather information, water characteristics, wind/wave/water patterns, and biological and chemical parameters that inform key business, policy, and public health decisions in the Great Lakes. Underpinning all of these observations is the lakefloor itself, an area woefully lacking in up-to-date high-density data collected to modern standards with new technologies.

It may sound cliché, but it's true: we know more about the surface of Mars than we do of our own planet. With only 13%[1] of U.S. Great Lakes waters mapped to modern standards, we know surprisingly little about the world's largest freshwater ecosystem that serves tens of millions of people and supports a massive economy. Meanwhile, we have nearly complete coverage of the surface of Mars at a higher density than exists for the Great Lakes. That's downright embarrassing.

The Great Lakes Mapping Act seeks to increase data density by a thousand-fold in many parts of the Lakes, dramatically improving our ability to manage and protect this vital resource.

Importance of the Great Lakes
Mapping data above and below the waterline in the Great Lakes is an essential missing component for the people and industries that call this region home.

Unlike Mars, the Great Lakes region is home to over 40 million people in two countries, eight states and one province. It is the world's largest freshwater lake system with a coastline of 4,350 miles[2]. Five lakes, Superior, Michigan, Huron, Erie, and Ontario make up the Great Lakes with depths, ranging from 30 feet in the shallowest of places in Lake Erie to nearly 1332 feet in Lake Superior. The total area of all the Great Lakes, including Canadian waters, is 94,250 square miles – approximately the size of the state of Oregon. Supporting major international cities, such as Chicago, Toronto, Detroit, Cleveland and Milwaukee, the Great Lakes supplies drinking water to approximately 30 million people, 10% of the U.S. population.

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[1] Integrated Ocean and Coastal Mapping, 'U.S. Bathymetry Coverage and Gap Analysis', Integrated Ocean and Coastal Mapping, 2024, https://iocm.noaa.gov/seabed-2030-bathymetry.html (accessed 14 March 2024).
[2] F. Klug, 'Great Lakes have the most miles of coastline in the contiguous US', *MLive,* 2 April 2013, https://www.mlive.com/news/2013/04/who_has_more_miles_of_coastlin.html (accessed 14 March 2024).

Economically, the importance of the Great Lakes cannot be understated. The total economy for the U.S. Great Lakes region generates approximately $3.1 trillion in gross domestic product (GDP) while employing 25.8 million people and supporting $1.3 trillion in wages. This is due in large part to the five major ports in the region: Chicago, Cleveland, Detroit, Duluth, and Milwaukee[3]. When combined with Canada, this represents over a $6 trillion GDP, the 3rd largest in the world, if the Great Lakes region were its own country.

Our blue economy underpins everything. The Great Lakes support a vibrant $7 billion commercial fishery, shipping, recreational boating, heavy industry, telecommunications, freshwater management, tourism, and all the related businesses that support these industries.

Mitigating Environmental Impacts

Researchers around the lakes are working hard to understand the full impact of environmental and public health threats such as pollution of our drinking water and increasing invasive species affecting our fisheries. In order to do that, they need the full picture, water depths, lakebed configurations, shoreline delineations so that they assess the impacts and recommend resilience and adaptation strategies to local decision-makers.

The Great Lakes are a dynamic environment challenged by legacy impairments with new stressors and threats that emerge every year. There are more than 180 non-native species[4] that have been introduced into the Great Lakes through the ballast water of seagoing ships, sometimes from other countries. Sea lamprey, alewife, dreissenid mussels, round gobies, and the spiny water flea are all examples of invasive species that have affected or are affecting Great Lakes fisheries[5]. An estimated 750 trillion mussels are carpeting the lake floor. These mussels muscle out native species and disrupt the food chain by siphoning out nutrient-rich plankton that fish also need to survive[6]. The collective invasive species are responsible for the loss of 18 fish species in at least one Great Lake[7].

Runoff, water level fluctuations, ice cover, or lack thereof, wind and storm events, as well as other human and nature induced impacts further affects the Great Lakes. This winter, Lake Superior is experiencing a historic low with ice cover less than 2 percent in February[8]. The variability and diminishing of ice cover for the past several decades has heavily influenced the nearshore waters and altered historic sediment distribution patterns. Industry, homeowners, businesses and those who enjoy recreation on the Great Lakes have established themselves along the shores where coastlines can change. Fluctuating lake levels and coastal erosion can cause hundreds of thousands of dollars of damage in a single year and upwards to several million dollars in a single storm event. Improved mapping data would aid researchers in assessing the extent of these challenges and devising effective strategies to mitigate them.

The State of Our Maps

Before NOAA's Lake Survey Center closed its doors in 1976, the Great Lakes were surveyed at low density with what is now obsolete technology. Since then, there has not been a concerted effort to map the Great Lakes until NOAA brought its hydrographic survey vessel *Thomas Jefferson* to the region in 2022. The Great Lakes Mapping Act aims to make that level of effort routine. With over eight states and a Canadian province

[3] NOAA Office of Coastal Management, 'NOAA Regional and State Report on the U.S. Marine Economy', NOAA Office of Coastal Management, 2023, https://coast.noaa.gov/data/digitalcoast/pdf/econ-report-regional-state.pdf (accessed 14 March 2024).

[4] Shedd Aquarium, 'Great Lakes Invasive Species: 180 and Counting', *Shedd Aquarium*, 20 February 2020, https://www.sheddaquarium.org/stories/great-lakes-invasive-species-180-and-counting (accessed 14 March 2024).

[5] Great Lakes Fishery Commission, 'Invasive Species', *Great Lakes Fishery Commission*, 2024, http://www.glfc.org/invasive-species.php (accessed 14 March 2024).

[6] K. Lavey, 'How do you get rid of 750 trillion mussels in the Great Lakes', *Detroit Free Press*, 22 February 2017, https://www.freep.com/story/news/local/michigan/2017/02/22/zebra-quagga-mussels-great-lakes/98242180/ (accessed 14 March 2024).

[7] Great Lakes Fishery Commission, 'Invasive Species', *Great Lakes Fishery Commission*, 2024, http://www.glfc.org/invasive-species.php (accessed 14 March 2024).

[8] P. Huttner, 'Where's the ice? Historic low Superior and Great Lakes ice cover', *MPR News*, 22 February 2024, https://www.mprnews.org/story/2024/02/22/wheres-the-ice-historic-low-superior-and-great-lakes-ice-cover (accessed 14 March 2024).

surrounding the lakes, there is no state level jurisdictional agency responsible for this type of work, nor does the computing infrastructure exist at the state level to handle this volume and type of specialized data.

Legacy and current efforts for national mapping have deprioritized the Great Lakes in favor of U.S. ocean coastal waters. With much of the depth data for the Great Lakes over 50 years old, in a dynamic environment, our understanding of the lakebeds and their relationships with habitat, subaqueous processes, invasive species, and coastline erosion is limited, introducing significant risk into science, policy, management, and day-to-day business operations.

The Great Lakes Mapping Act
The Great Lakes Mapping Act seeks to reverse course and chart a new direction for fully mapping the underwater environment of the Great Lakes, all within a relatively short time frame. There are two primary goals of the bill.

The first is to use new and improved technologies to comprehensively survey the Great Lakes to modern standards and in high-density. This activity includes the collection of and processing of bathymetric construction of a high-resolution digital elevation model of the lakebeds.

The second primary goal of this bill is related to data sharing for widespread, equitable access to the data, which will be useful for so many purposes. Data sharing will depend heavily on high quality metadata and data archive for accessibility. GLOS, as the IOOS Regional Association for the Great Lakes, will work with NOAA and partners to build and release integrated high resolution maps and digital elevation models as data is acquired.

Based upon the work undertaken by GLOS[9] and assessments done by three separate survey companies, the estimated total cost for this effort is $200 million.

Impact and Benefit of the Great Lakes Mapping Act
Foundational Dataset
This type of mapping data and information is considered a foundational dataset, meaning it is essential data to have in order to understand the geospatial context, make decisions, realize opportunities, and plan investments. Across the United States, and even in the states surrounding the Great Lakes, we have mapped our land elevations to much higher accuracy and density than the Great Lakes themselves. We need to understand the bathymetric composition of our Great Lakes themselves, and combine this information with the surrounding topography for a complete picture. For a resource that supplies drinking water to tens of millions of people, supports a massive economy including a fishery and shipping, is a complex ecosystem threatened by a changing climate, coastal processes and invasive species, it is in the national interest to fully map our Great Lakes waters in short order.

Economic
The economic benefits of investing in this initiative are comprehensive. NOAA's Blue Economy Strategic Plan for 2021-2025 aims to advance America's Blue Economy and enhance the global ocean economy. This includes the Great Lakes. A commercial fishery is better informed, better managed and would likely yield higher revenues with a better understood lakebed. Shipping routes would have more up to date information, for safer navigation and greater access with more accurate data, reducing risk and saving time and money in commercial operations. Tourism and recreational activities are increased, driving revenues, directly impacting local economies, creating jobs and providing new opportunities for companies to establish themselves in the region. Technology innovation is a natural consequence of investing in this initiative. The Great Lakes are a perfect test bed for new technology development. Similar conditions exist in the Great Lakes as the high Arctic, an area that is primed for new exploration with warming polar regions and increased shipping traffic. Preparing a workforce to support this burgeoning industry goes hand-in-hand with educating, attracting and retaining

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[9] https://glos.org/wp-content/uploads/2021/12/Costs-and-Approaches-for-Mapping-the-Great-Lakes.pdf

talent in the region, further enhancing the economic benefits. Mapping the Great Lakes can ultimately help the economic transformation of the region from the 'rust belt' to the 'blue belt'.

Environmental
From an environmental perspective, the Great Lakes are changing. This year, the city of Duluth had an ice-free winter on Lake Superior. Temperatures are warming, water levels are fluctuating, the shoreline is changing, algae blooms are increasing, the ecology is changing, and large rain events are becoming more predominant. All of these have impacts on the lakebeds of which we have very little baseline knowledge of. Coastal resilience is an important theme for NOAA and stormwater runoff is a major threat. One of the primary activities to improving management of stormwater runoff is fully understanding the underwater environment impacted by this human activity. Human migration is anticipated to dramatically increase, bringing hundreds of thousands of people to the region, all requiring drinking water. New infrastructure will be required to support this growth and a well understood lakebed will aid in this decision making. More research is required to better understand all of these environmental indicators of change in the Great Lakes and having a foundational dataset is critical to the human knowledge required for the protection and preservation of the Great Lakes. Without it, the economic impact would be profound. More efficient decision making, impacting a wide range of beneficiaries and constituents, would be made as a result of having access to better data.

Investing in mapping the Great Lakes will undoubtedly see an almost immediate return on investment economically, environmentally and in areas that represent opportunity.

The Great Lakes Mapping Act can be executed successfully and efficiently by leveraging the power of organizations that span jurisdictions, have federated partner networks and non-commercial interests in facilitating the two primary goals of the bill. In support of the goal of 'High-resolution Lakebed Mapping', a qualified organization would utilize existing reports on prioritization, gap analysis and strategic areas of importance to set priorities, coordinate mapping efforts and facilitate communication and management. Working with other stakeholders, a high-resolution map would be created while in process and at the completion of the effort, lead the development of a methodology and implementation of a process for data processing and work with partners on an efficient use of existing and new cyberinfrastructure resources for data management, cataloging, archival and metadata management. Supporting the second goal, 'Data Sharing', a regionally certified authority under NOAA would provide public access points for data and metadata discovery, download, map visualization and sharing both during and after the mapping effort. This includes ensuring that all relevant and approved data is archived within Federal government data holdings and made publicly available. The development of high visibility products, such as maps, models and related information would be coordinated and communicated to a wide range of stakeholders for effective and future decision making that benefits the economy, environment and American people.

Investment and Conclusion
The Great Lakes Mapping Act is an investment in the future of the Great Lakes. The direct economic benefits from better supporting the commercial fishery, commercial shipping, growing tourism and recreation, protecting infrastructure and coastline, growing and retaining a workforce that stays in the region while growing the blue economy are significant. From an environmental perspective, the Great Lakes have a lot to gain with this foundational dataset. Understanding the risks from invasive species on the lakebed, unveiling discoveries of the deep - both human, such as shipwrecks, and geologic, such as mineral or gaseous deposits all impact the economic picture of the Great Lakes. Using this data to understand the effects of a changing climate, stormwater runoff, coastal processes, benthic habitats and decreasing ice coverage impacts enable the research community to make informed decisions that affect economic sustainability of a wide range of industries. Human migration is poised to significantly grow the population of the Great Lakes, putting strain on a fragile freshwater ecosystem that supplies drinking water to many Americans. This data helps prepare for that eventuality. Current Great Lakes bathymetry is decades old, low density and captured with obsolete technology. The Great Lakes Mapping Act will see comprehensive high-density data collected to modern standards and made publicly available through intuitive discovery tools. This brings the region up to par with other U.S. coastal areas for having the kind of coverage and depth data required for effective and efficient decision making that impacts millions of lives and businesses in one of the largest economies in the world.

This effort is able to take advantage of established organizations via NOAA, IOOS and GLOS that already work with large partner networks that include state, federal, local and commercial interests. Furthermore, supporting technologies and computing infrastructure already partially exists to facilitate the collection, cataloging, storing, processing, modeling, sharing and visualization of this comprehensive data and high-resolution map of the Great Lakes.

The return on investment for mapping the Great Lakes benefits America, the American people, American business and perhaps most importantly, the future of the Great Lakes.

Support for the Great Lakes Mapping Act

"As Director of the Great Lakes Acoustic Telemetry Observation System (GLATOS), a binational research effort with a mission of understanding the movements of Great Lakes fish, the need for high-resolution bathymetric mapping of the lake beds is imperative. GLATOS researchers are able to understand fish movement patterns at unprecedented scales with acoustic telemetry technology; however, without precise information about what habitat these fish are using (i.e., via high resolution lake bed mapping) a large information gap exists. A concerted high-resolution mapping effort across the Great Lakes Basin would allow researchers and managers to better understand native fish critical habitat use (i.e., for spawning, nursery and foraging) to ensure these economically and ecologically important species persist in the face of climate change."
> *Christopher S. Vandergoot*
> *Director, Great Lakes Acoustic Telemetry Observation System*
> *Associate Professor, Michigan State University*

"High-resolution bathymetry data for the lakebed would be tremendously beneficial to sustainable management of the Great Lakes fishery, said Dr. Marc Gaden, executive secretary of the Great Lakes Fishery Commission, a Canada-US treaty organization. We need these data for the whole of the Great Lakes. Bathymetry data would allow us to link fish movement and behavior to specific habitat; would allow us to identify, protect, and improve areas most important to fish spawning and fish recruitment; and would help us better predict fishery production in areas where good habitat data are otherwise unavailable.   Moreover, from a whole lake perspective, high-resolution bathymetry would allow us to develop better models and tools to better understand occupancy and ecosystem function, and allow fishery managers to work more effectively with their water quality counterparts. The Great Lakes Fishery Commission and its partners look forward to the day when these tools are available in the Great Lakes basin."
> *Marc Gaden, PhD*
> *Executive Secretary*
> *Great Lakes Fishery Commission*
> *2200 Commonwealth Blvd. Ste 100*
> *Ann Arbor, MI 48105*

Further information regarding mapping in the Great Lakes can be found in ***Attachments 1 and 2.***

Attachment 1 - Great Lakes Mapping1Pager v5.
Attachment 2 – Costs and Approaches for Mapping the Great Lakes.