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The National Map Corps—Federal Emergency Management Agency and Oak Ridge National Laboratory Pilot Project Report

Open-File Report 2025–1052

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By Tatyana Dimascio, Greg D. Matthews, and Erin M. Korris

U.S. Department of the Interior
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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
	Area	
square foot (ft^2)	929.0	square centimeter (cm^2)

Abbreviations

AI	artificial intelligence
CEGIS	Center of Excellence for Geospatial Information Science
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
NGTOC	National Geospatial Technical Operations Center
NSDI	National Spatial Data Infrastructure
ORNL	Oak Ridge National Laboratory
TNMCorps	The National Map Corps
U.S.A.	United States of America
USGS	U.S. Geological Survey

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Abstract

This report provides an overview of the U.S. Geological Survey National Map Corps —Federal Emergency Management Agency and Oak Ridge National Laboratory pilot project in St. James Parish, Louisiana, that began in February 2024 and ended at the end of March 2024. The project used the power of The National Map Corps' volunteer community to improve building classifications in the original Federal Emergency Management Agency's U.S.A. Structures dataset. The report highlights the project's completion and details the work and results achieved through a collaborative effort to enhance geospatial data quality and utility.

Introduction

As part of the National Geospatial Technical Operations Center (NGTOC), The National Map Corps (TNMCorps) is a crowd-sourced mapping project that relies on volunteers to assist the U.S. Geological Survey (USGS) National Geospatial Program by collecting and editing built structures data.

Tracing its initial discussions to a 2020 meeting between the Federal Emergency Management Agency (FEMA) and USGS personnel, the St. James Parish pilot project took place from February through March of 2024. The project focused on exploring opportunities to utilize TNMCorps platform for improving data quality and addressing mission needs of FEMA and USGS. TNMCorps partnered with FEMA to use the power of TNMCorps' volunteer community to improve building classifications in the original FEMA U.S.A. Structures dataset.

The improvement of the U.S.A. Structures dataset is a collaborative effort between FEMA's Response Geospatial Office, Oak Ridge National Laboratory (ORNL), and the USGS to build and maintain the Nation's first comprehensive inventory of all built structures larger than 450 square feet (ft^2) for use in flood mitigation, emergency preparedness, and response. For a list of key staff involved in this effort, please refer to appendix 1.

The goal of the collaboration is to enhance the U.S.A. Structures dataset's occupancy type attribution (for example, residential, industrial, and government) by augmenting ORNL's automated workflow with verification and refinement by TNMCorps volunteers. The success of this pilot project could lead to a more versatile dataset for multiscale mapping, improve emergency decision-making, and foster interagency cooperation. Ultimately, this effort could help to expand the dataset's utility and contribute to future cartographic solutions for the USGS. Figure 1 summarizes key collaborators, goals, process, benefits, and effects of the project.

**Figure 1.** Key collaborators, goals, process, benefits, and effects of the U.S. Geological Survey National Map Corps (TNMCorps)—Federal Emergency Management Agency (FEMA) and Oak Ridge National Laboratory (ORNL) pilot project in St. James Parish, Louisiana.

Project Area

The pilot project focused on St. James Parish, Louisiana (fig. 2). FEMA identified this region as a high-priority area due to its vulnerability to flooding and storms. Selecting this area allowed for testing the project's efficacy in a region with a high concentration of structures that benefited from the use of accurate data.
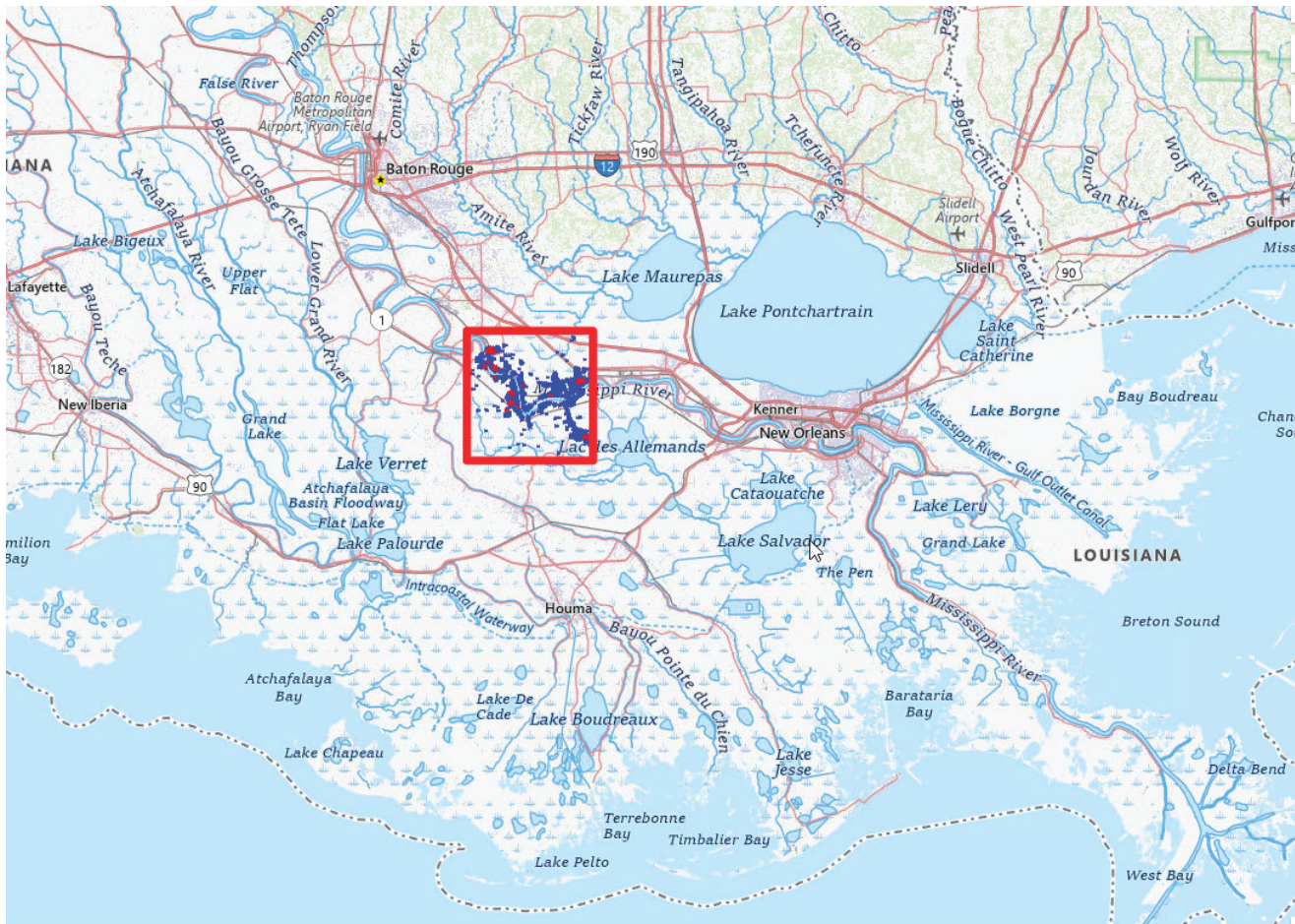
Base from U.S. Geological Survey Topographic Map digital data, various scales.
FEMA U.S.A. Structures digital data.
World Geodetic System 1984

Figure 2.   Map showing the St. James Parish project area in Louisiana. The project area is highlighted in red on a map of St. James Parish and surrounding areas. The Federal Emergency Management Agency's U.S.A. Structures dataset is displayed as blue rectangles.

Methods

The project implements an innovative methodology that combines automated classification with citizen science contributions to enhance structural classification accuracy across the United States. The ORNL has developed an automated multistep classification process that draws from machine learning in combination with 62 distinct source mapping data layers to classify structure occupancy types (Hauser and others, 2023; Yang and others, 2024). When structures lack sufficient source data for classification through traditional data conflation and fusion methods, a machine learning model is used to determine the appropriate classification.

In St. James Parish, out of 12,328 total structures, 750 required machine learning classification due to gaps in availability of the source data layers. Through the help of TNMCorps volunteers, we discovered a 15-percent error rate in the source data. Subsequent crowdsourced improvements eliminated detectable errors in the dataset.

This verification process through TNMCorps has generated valuable data that can be used to refine ORNL's classification methodology. The two-step process, combining automated classification with human verification, demonstrates the effectiveness of hybrid approaches in achieving highly accurate structural classification data.

To enhance the accuracy of FEMA's U.S.A. Structures dataset, TNMCorps volunteers, guided by detailed instructions (app. 2, app. 3, and app. 4), thoroughly reviewed and refined the classifications through a customized TNMCorps editing platform (fig. 3). This two-step process integrated automated classification with human verification to improve data quality.

Base from U.S. Geological Survey Imagery Topographic Map digital data, various scales.
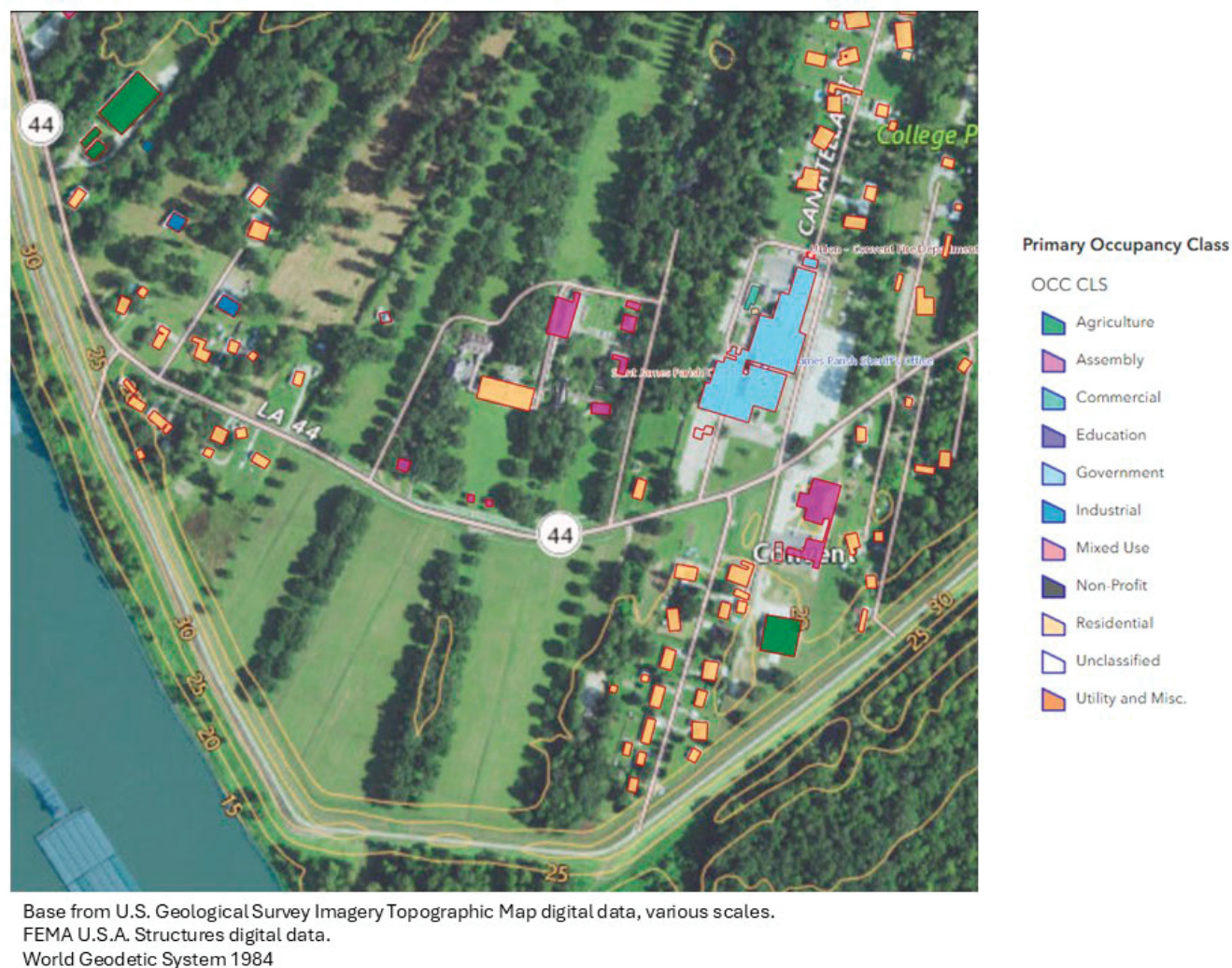FEMA U.S.A. Structures digital data.
World Geodetic System 1984

Figure 3.   Example of structures editing using The National Map Corps' customized editing platform.

Results

This pilot project indicated that the ORNL manually verified a random sample of 100 volunteer-modified records, confirming a 100 percent accuracy rate for checked structures. During a one-month period, 1,800 edits were made using the editing platform, significantly refining classifications and descriptions within the dataset. Reviewers either agreed with the modified classifications from TNMCorps or found no compelling information to dispute the new classifications.

The ORNL expects to incorporate the feedback on occupancy types in the upcoming dataset update and cite that the validation was performed by the USGS TNMCorps. The modifications volunteers made were particularly helpful in identifying vulnerable areas and structures such as manufactured homes. The validated volunteer feedback was incorporated into the latest dataset deliverable made to FEMA.

Discussion

The sections below summarize project challenges and how they were addressed. They also include a discussion of benefits, future opportunities, and a long-term vision.

Overcoming Challenges

The project did encounter challenges, including initial concerns regarding data access, determination of occupancy classification, and the complexity of classifying structures with multiple occupancy types. For example, in Washington, D.C., buildings frequently have more than one occupancy type, which can affect data accuracy. Because of the complexity of classifying the data in Washington, D.C., the team collected data in Louisiana for the pilot project because occupancy types in Louisiana were more clearly defined. Volunteer feedback highlighted areas for platform improvement, such as providing more detailed instructions and refining categorization options.

To meet these challenges, the team iteratively refined the TNMCorps editing instructions, providing volunteers with comprehensive guidelines for classifying structures. They also focused on enhancing the editing interface's functionality, streamlining the editing process, and incorporating user feedback.

Project Benefits

The project demonstrated TNMCorps' ability to support the USGS's mission of enhancing geospatial data by using citizen science while also strengthening its position in the geospatial community through partnerships with FEMA and ORNL. Ongoing development of the editing platform could enhance cartographic capabilities, filtering options, and data attributes, enabling more precise emergency response

and cartographic enhancements. Users may benefit from customizable visualizations, enhanced analytical capabilities, and richer contextual data beyond traditional point files.

For FEMA, the improved data quality can directly enhance its emergency response efforts. As they noted in a presentation, "The coordinated campaign and peer-review mechanism resulted in high-quality feedback, leading to necessary corrections that enhance the integrity of our data" (T. Hauser and L. Yan, FEMA, written commun., 2024, slide 3). More precise information about structures enables more effective planning and resource allocation during disasters. FEMA is "refining our Model by incorporating detailed feedback on occupancy classifications, thereby elevating the overall quality of the USA Structures dataset" (T. Hauser and L. Yan, FEMA, written commun., 2024, slide 7). These improvements can allow for better mapping and data filtering, enabling faster and more accurate decision-making during critical emergency situations. Looking ahead, FEMA stated they "look forward to incorporating this valuable feedback and enhancing our datasets with accurate occupancy types where we previously lacked authoritative sources" (T. Hauser and L. Yan, FEMA, written commun., 2024, slide 7).

Additionally, this project supported the partnership between USGS, FEMA, and ORNL, laying the foundation for future collaboration that could benefit the broader Federal Geographic Information System (GIS) community. By enhancing the quality of geospatial data and supporting emergency response efforts, the project aligns with the National Spatial Data Infrastructure (NSDI) 2035 goals, emphasizing the importance of interagency collaboration, community engagement, and the leveraging of innovative technologies in the creation and management of spatial data (Federal Geographic Data Committee, 2024).

Potential Future Opportunities

The TNMCorps—FEMA and ORNL pilot project has generated significant interest in expanding the project's scope and application. Future opportunities may involve incorporating additional attributes, such as building floor counts, and prioritizing high-need areas like coastal regions and data-deficient zones. The user experience and data quality could be enhanced by implementing feedback-driven updates to the application and instructions. The following elements could be considered:

- Establish collaborative milestones with partners to prioritize key tasks.

- Set a clear quality goal, such as achieving 90–95 percent data accuracy.

- Quantify the full-time equivalent staff effort saved through crowdsourcing.

- Explore innovative technical integrations, like elevation for structure base and heights.

Key strategies:

- Continue collaboration with FEMA.

- Explore additional partnerships: engage the USGS Center of Excellence for Geospatial Information Science (CEGIS) and the U.S. Census Bureau.

- Leverage volunteers: scale up efforts through volunteer engagement.

- Explore advanced technologies: investigate knowledge graphs and artificial intelligence (AI) for data development and quality assurance.

Long-Term Vision

Building on the pilot project, we could develop a multi-agency editing platform to streamline collaboration across the Federal Government. This platform could integrate data from various sources, fostering a comprehensive and consistent understanding of the Nation's built environment. This vision highlights the project's potential to significantly advance geospatial data capabilities and support informed decision-making throughout the Federal Government.

Summary

The National Maps Corps—Federal Emergency Management Agency and Oak Ridge National Laboratory pilot project was completed in February and March of 2024. The project highlighted the use of crowdsourcing, interagency collaboration, and continuous improvement in enhancing data quality to inform critical decision-making.

By focusing on improving data locally—particularly in coastal areas and in regions with low data quality—the project not only addresses pressing regional needs but also contributes to a broader effect: enhancing overall national data quality through more accurate inputs for modeling. This dual benefit underscores the project's goal of improving data at a local level while simultaneously helping to address national-scale challenges. The project's outcomes and the interest in its continuation indicate that this innovative approach can be used across the Nation.

References Cited

Federal Geographic Data Committee, 2024, Building the geospatial future together—The NSDI [National Spatial Data Infrastructure] strategic plan 2025–2035—Goals and objectives: Federal Geographic Data Committee web page, accessed January 2, 2025, at https://www.fgdc.gov/nsdi-plan/NSDI2035GoalsandObjectives.

Hauser, T., Moehl, J., Schmidt, E., Adams, D., Whitehead, M., Morris, B., and Yang, H.L., 2023, U.S.A. Structures phase 2: U.S. Department of Energy, prepared by Oak Ridge National Laboratory, Oak Ridge, Tenn., under contract no. DE-AC05-00OR22725, 25 p., accessed December 22, 2024, at https://doi.org/10.2172/2076189.

Yang, H.L., Laverdiere, M., Hauser, T., Swan, B., Schmidt, E., Moehl, J., Reith, A., Adams, D., Morris, B., McKee, J., Whitehead, M., and Tuttle, M., 2024, A baseline structure inventory with critical attribution for the U.S. and its territories: Scientific Data, v. 11, art. 502, 15 p., accessed December 22, 2024, at https://doi.org/10.1038/s41597-024-03219-x.

Appendix 1.   Pilot Project Staff

The staff working on the St. James Parish pilot project included seven team leads from the U.S. Geological Survey, Federal Emergency Management Agency, and the Oak Ridge National Laboratory (table 1.1).

Table 1.1.   Project staff for the U.S. Geological Survey (USGS) National Map Corps (TNMCorps)—Federal Emergency Management Agency (FEMA) and Oak Ridge National Laboratory (ORNL) pilot project.

Name	Title	Contact information
Samuel Mix	FEMA Project Lead	samuel.mix@fema.dhs.gov
Lexie Yang	ORNL Project Lead	yangh@ornl.gov
Taylor Hauser	ORNL Technical Lead	hausertr@ornl.gov
Tatyana Dimascio	USGS Senior Researcher	tdimascio@usgs.gov
Erin Korris	USGS TNMCorps Project Manager	ekorris@usgs.gov
Joe Pantoga	Development Team Lead	jpantoga@usgs.gov
Greg Matthews	The National Map—Support Themes Lead	gdmatthews@usgs.gov

Appendix 2.   Testing Setup

The St. James Parish study area was split into 12 sections with an approximately equal number of structures to be reviewed within each section. The 12-section boundaries were loaded into the editing platform for the users to use during the review (fig. 2.1).

The National Geospatial Technical Operations Center (NGTOC) sent out a call for volunteers in The National Map Corps (TNMCorps) volunteer community. The first 10 volunteers to respond were included in the testing. The message asked for a month-long commitment. Volunteers were asked to review existing assigned building occupancy classifications in the customized TNMCorps platform and update them as needed. Additionally, two NGTOC staff were assigned to review two sections to have coverage for all 12 sections in the study area. NGTOC created a tracking table to monitor section assignments and completion status (fig. 2.2).

The NGTOC created a testing form for the reviewers to use for feedback (fig. 2.3). The form captured responses on the following items:

1. Volunteer contact.

2. Usability of editing platform's home page.

3. Searching for a location on the map.

4. Usability of the "About" and "Help" pages.

5. Process for adding a service layer.

6. The building review process in the assigned section to verify or update occupancy classifications as needed (U.S. Geological Survey, undated, page 13; app. 4). All edits and verifications should be supported by local knowledge or corresponding research.

7. Additional comments.

Ten TNMCorps volunteers and two NGTOC staff signed up for testing. Five volunteers were not able to complete the review of their entire area in the assigned timeframe. NGTOC staff completed the review of these areas. Volunteers were provided with testing instructions (app. 3) and a user guide (U.S. Geological Survey, undated; app. 4).

References Cited

U.S. Geological Survey, [undated], The National Map Corps (TNMCorps)—FEMA [Federal Emergency Management Agency] Building Classification Collaborative Pilot Project User Guide: U.S. Geological Survey web page, 22 p., accessed February 2025 at https://edits.nationalmap.gov/apps/tnmcorps-fema/user-guide.
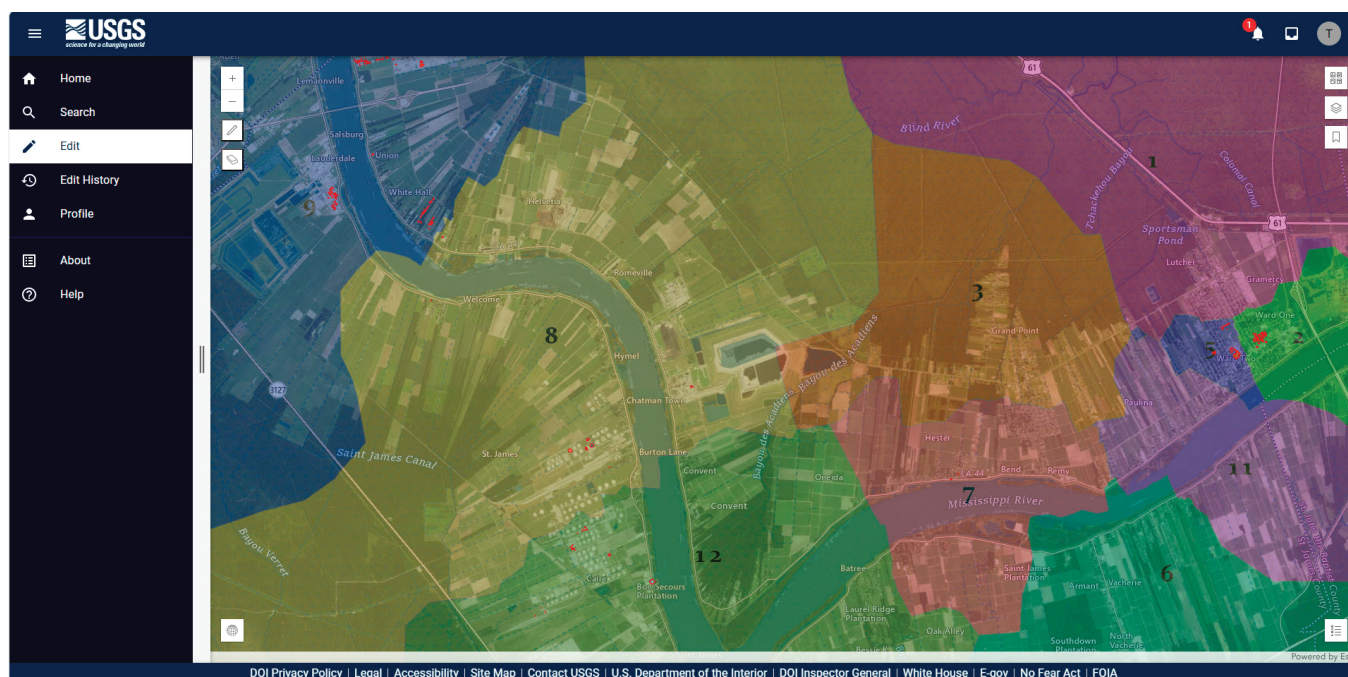

Figure 2.1. Twelve review sections in The National Map Corps' editing platform.

Volunteer Name	Email	Assigned St. James Parish Section	Week assignments for NGTOC staff	Status
		1		
		2		
		3		
		4		
		5		
		6		
		7		
		8		
		9		
		10		
NGTOC staff		11		
		12		

Figure 2.2. Review progress tracking table. NGTOC, National Geospatial Technical Operations Center.

Figure 2.3.   Testing feedback form provided to The National Map Corps volunteers.

Appendix 3.   Testing Instructions

Thank you for volunteering your time to test [The National Map Corps] TNMCorps' [Federal Emergency Management Agency] FEMA application and review existing assigned building occupancy classifications!

Objective: To test and provide feedback for the TNMCorps' FEMA application functionality, as well as review building occupancy types in the St. James Parish study area.

Testing requirements and timeline: Please review building occupancy types ONLY in your assigned section. Your assignment will be provided via email. You can submit the testing form after reviewing a small subset of the occupancy classifications in your section. Then you have until March 26th to continue the review of as many occupancy classifications in your assigned section as possible. If you are done with your section prior to March 26th, please let us know. If you are not done with all buildings in your section on March 26th, please send us your status update.

Testing Form Instructions: Please review The National Map Corps (TNMCorps)—FEMA Building Classification Collaborative Pilot Project User Guide (U.S. Geological Survey, undated; app. 4) and then go through the steps outlined in the Testing Form. Note in the answer space if you run into any issues, get results different from descriptions in the User Guide, or have any other feedback.

Website: https://edits.nationalmap.gov/apps/tnmcorps-fema

Contact Information: For any inquiries related to the FEMA application testing, please email nationalmapcorps@usgs.gov and include "FEMA testing" in the subject line.

Testing Section Assignments: A map layer with testing sections (colored and numbered, fig. 3.1) has been added to the application for testing purposes to help with splitting up the total number of occupancy classification features in the study area into equal parts. This layer is for testing reference only and can be turned on and off. To turn it on or off, click on the Layers icon in the top right corner of the map view (1), then click on the eye-shaped icon to hide or reveal the Sections layer (fig. 3.2).

References Cited

U.S. Geological Survey, [undated], The National Map Corps (TNMCorps)—FEMA [Federal Emergency Management Agency] Building Classification Collaborative Pilot Project User Guide: U.S. Geological Survey web page, 22 p., accessed February 2025 at https://edits.nationalmap.gov/apps/tnmcorps-fema/user-guide.
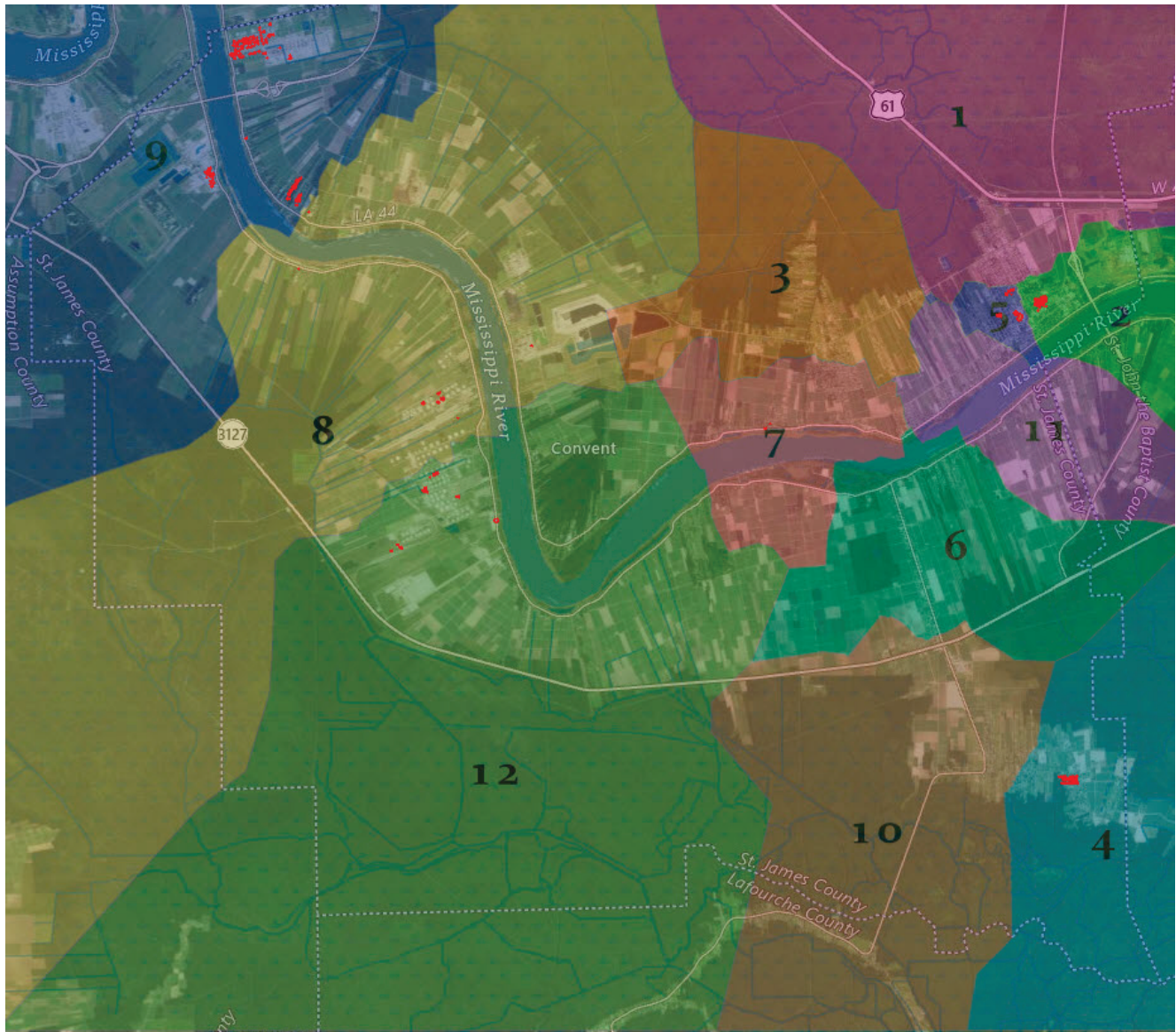
Figure 3.1.   Sections layer in the map view for testing sections as part of the National Map Corps—Federal Emergency Management Agency and Oak Ridge National Laboratory pilot project. Colored polygons are individual editing sections. Numbers are section numbers.
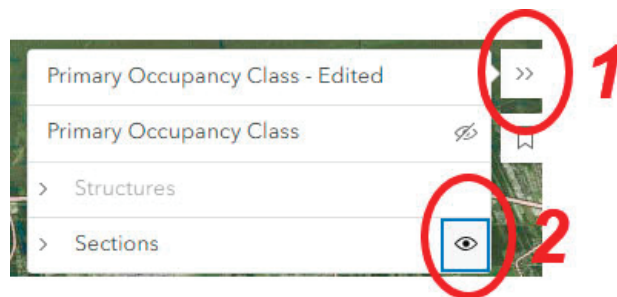

Figure 3.2.   Hiding and revealing the sections layer in the map for testing sections as part of the National Map Corps—Federal Emergency Management Agency and Oak Ridge National Laboratory pilot project. Step 1 is to open the list of layers. Step 2 is to turn the sections layer on or off.

Appendix 4.   User Guide

The National Map Corps (TNMCorps)—FEMA [Federal Emergency Management Agency] Building Classification Collaborative Pilot Project User Guide can be viewed here: https://edits.nationalmap.gov/apps/tnmcorps-fema/user-guide